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## X-Ray Evidence of Old Forgotten or Previously Undiagnosed Fractures<sup>1</sup>

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WHEN A PATIENT sustains a fracture, will he know it (a) at once or (b) some time later? Certainly it is a concept rather regularly accepted by the laity that when a bone is broken there is considerable pain, and more or less dysfunction is also to be expected. Medical opinion would accept this concept as true in the large majority of cases, but every physician seeing injury cases has the experience of occasionally finding fractures which have escaped clinical diagnosis altogether and of noting complete lack of immediate disability and relative absence of pain in some of these patients.

The location of the fracture and the importance of the bone affected in permitting free function of the part are undoubtedly significant factors. The pain threshold of the individual is another important consideration in determining whether or not medical attention and diagnosis are sought, leading to an immediate diagnosis of fracture. Religious convictions may at times militate against prompt diagnosis. We have seen several fractures undiagnosed for months, the chief factor contributing to the delay being the religious faith of the patient, which encouraged him to get along without a physician's attention.

That every fracture must immediately cause the patient considerable pain, so that he will probably remember the time and circumstances of the injury throughout the remainder of his life, and that self-noted disability will follow, more or less promptly, are often argued by attorneys in court or before industrial commission examiners when a diagnosis of fracture has first been made months or even years after its occurrence. If the client can honestly testify that he has no recollection of having previously injured his wrist, chest, ankle, or other part, or of receiving any treatment for fracture or serious injury, and the medical witness testifies that the radiographic studies point clearly to an ancient, previously undiagnosed fracture, the attorney will sometimes attempt to belittle the medical evidence by asking confidently, for the benefit of the jury, or commissioner, and his client: "Don't you think, Doctor, that if my client did fracture this wrist years ago, as you contend, he certainly would be able to remember that fact now and he would surely have consulted a doctor?"

It is our impression that it is not unusual for certain fractures, notably of the carpal scaphoid, the mid and lower ribs, the metatarsal, metacarpal, and phalangeal bones, to pass undiagnosed and untreated as fractures. Some of these missed

<sup>1</sup> Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1-2, 1943.



Fig. 1. Case 1: Old, unrecalled healed fracture of 11th rib (arrows) and fresh fracture of 10th rib (circled) following a recent fall. Old rib injuries stoutly denied.

diagnoses are followed by excellent functional recovery, and later only radiographic deformities can be found as positive evidence of an old healed fracture. In such cases no one is the "loser." When, however, a carpal scaphoid fracture, for example, is diagnosed for the first time only years after the original injury, following further trauma, considerable dissatisfaction on the part of the claimant and his attorney is likely to follow if the gradually evolved deformity or dysfunction is not fully compensated for financially. It is under such circumstances as these that the attorney will attempt to discredit the testimony of the radiologist, industrial surgeon, or orthopedist, who states with conviction and complete honesty that the fracture revealed is an old one, dating back at least a year or more, leading gradually to the development of secondary traumatic arthritis and/or nutritional disturbance with gradually increasing pain and dysfunction.

Except for the discrepancy between the

history and the x-ray findings, there is nothing very unusual about most of the fractures discussed in this paper. They occur in the usual location in bones commonly involved in fractures, and their manner of healing has been, in most instances, according to the usual pattern.



Fig. 2. Case 2: Old, unrecalled, previously undiagnosed fractures of 6th and 7th ribs, left. No previous chest injuries recalled or admitted.

The chief purpose in presenting this material is to emphasize the occasional lack of correlation between past history and medical care on the one hand and the x-ray findings on the other. So regularly have we been taught to be guided by the history and, often very properly, to disregard laboratory or x-ray findings when they are in disagreement with clinical observations and history, that we tend to overemphasize the reliance to be placed on the latter. These cases show either that there may be failure of memory of the incident or accident which caused the fracture revealed months or years later in the x-ray studies, or, what is probably the more usual correct explanation, that there was not sufficient pain or dysfunction to impress the circumstance

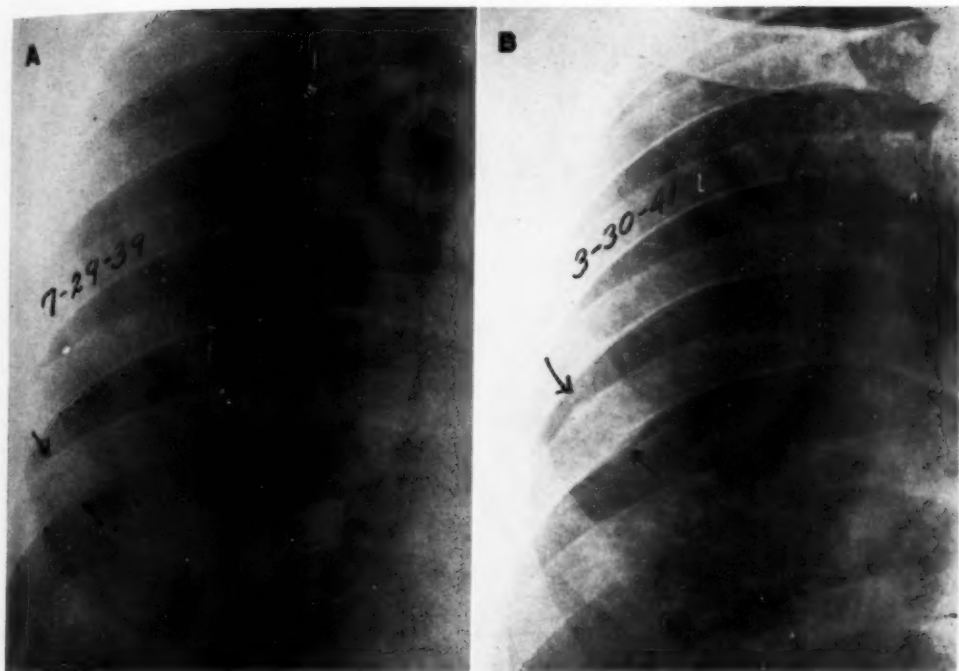


Fig. 3. Case 3: A. Essentially normal chest. B. Same chest approximately two years later, showing healed fracture of right 8th rib. In testimony before an Industrial Commission the patient denied any recollection of chest injury, though this must have occurred less than two years earlier as proved by serial films.

indelibly upon the patient's mind. The natural healing which followed, despite lack of physician-attention resulted in complete recovery or in sufficiently complete recovery for the time being to make it impossible at the later date to correlate the x-ray evidence of an old fracture with the exact time of its occurrence and the exact circumstances under which it was sustained.

Rib fractures are a bit different from other fractures. Some physicians contend that if an injury is sustained to the chest wall, barring concurrent intrathoracic trauma, it makes little difference, except for medicolegal purposes, whether or not a diagnosis of rib fracture or fractures is established, since treatment to relieve the pain, by strapping, is quite the same whether a fracture is radiographically demonstrated or is left unstudied. This attitude we consider outmoded, particularly if any question of compensation is involved, both because of occasional intra-

thoracic complications, which cannot always be diagnosed clinically, and because of the possibility of a late claim for the activation or aggravation of a pre-existing tuberculosis or other chronic disease, the presence of which was not studied carefully at the time of the injury. We hold that in all injuries to the thoracic cage, except possibly those low down posteriorly, over the level of the 11th and 12th ribs, beneath which no portions of the intrathoracic structures lie, the patient should have the benefit of at least a single rapid-exposure postero-anterior teleroentgenogram of the entire chest for the purpose of lung and heart study, so that the presence of any pre-existing pulmonary or demonstrable cardiovascular lesion may be recorded at the time of checking the ribs and other bony structures for fractures. Only by making this a routine, will the radiologist or industrial physician be in a position to evaluate the relationship between the

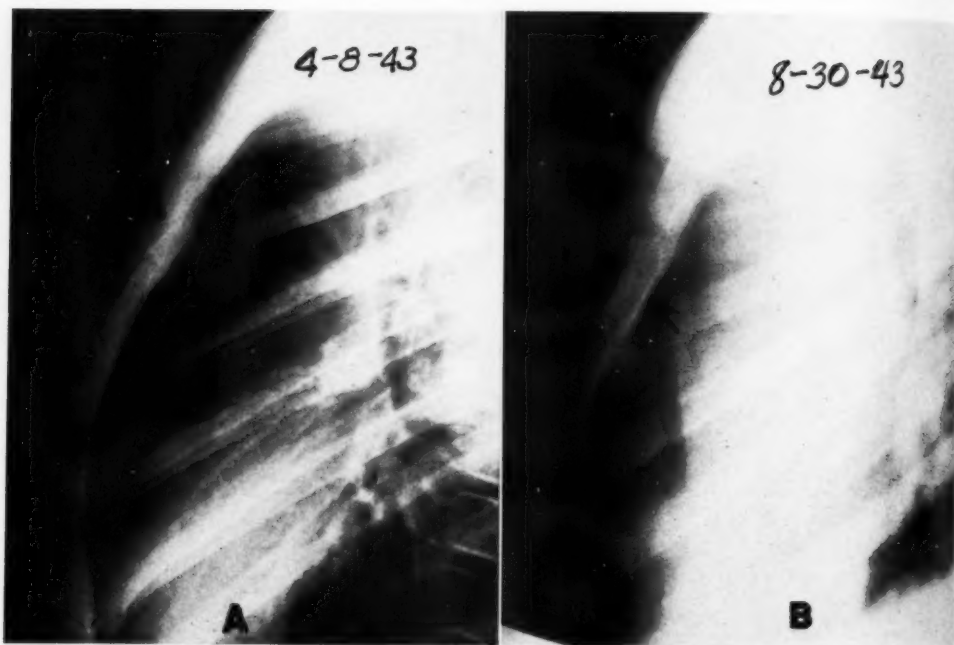


Fig. 4. Case 4: A. Recent fracture of upper sternum, not previously recognized or suspected, revealed by x-ray study because of breast nodule. The patient, a 13-year-old boy, had fallen five weeks previously but had no recollection of striking any part of the chest wall.

B. Film made five months later, showing mature healing of sternum fracture, proving finally its occurrence shortly prior to first x-ray study.

chest injury and a subsequently developing tuberculosis or other intrathoracic disease process which later may become manifest clinically.

Fractures occurring under unusual circumstances, as, for example, complete transverse fracture through the mid portion of the patella in a young adult as a result of muscle pull only, with no direct blow to the part, may conceivably be missed because the history may be somewhat misleading to the physician with no previous experience of fracture from this cause alone. Such fractures, however, if amenable to correct physical diagnosis, would not go unrecognized and unstudied radiographically.

Fractures occurring in patients with syphilis of the central nervous system or other disease which may make for a high threshold of pain perception may be missed even though there is a history of trauma adequate to produce fracture, if the

physical examination gives no suggestive findings. Such patients may be dismissed as having contusion or sprain only, until some later occasion justifies radiography and reveals the previously missed fracture, now an ancient one.

Sometimes it is simple stubbornness on the part of the patient, in holding to his original self-diagnosis of "nothing broken," which sustains him in his decision to do without medical care; or, rarely, where so-called minor injuries may be handled by an industrial nurse, the decision may be made by her that a physician's attention is not necessary.

Jordan-Narath (2) discussed at some length fractures which are missed radiographically if examination is done too soon, inadequately, or inexpertly. He placed no emphasis, however, on ancient fractures revealed by x-ray study, for which no history of injury was obtainable.

Owen (4) points out the likelihood of



overlooking a fracture in one part of the body (for example, the spine) when a fracture elsewhere focuses the attention of the examiner at that level (for example, the femur or tibia) because of greater pain and deformity, but he, too, makes no mention of encountering positive evidence of old healed or unhealed fracture where no history of injury was recalled.

Lancer (3) stated a principle fifteen years ago, now rather generally accepted by radiologist, orthopedist, and industrial surgeon alike, that "in many cases the x-ray diagnosis is the sole proof of fracture," but, like others, he had apparently not been impressed with the occasional lack of correlation between the roentgen evidence of old fracture and the patient's past history.

#### OLD CHEST INJURIES

Radiologic differentiation between normal chests and "healthy adult" chests has long been recognized and understood by radiologists. A Ghon's focus, calcified hilar or mediastinal lymph nodes, pleural adhesions affecting the diaphragm, and slight thickening of the interlobar or apical pleura, have all been accepted as changes which may be present singly or in combination and still permit the interpretation of "healthy adult" chest. We believe one could add to this list the observation of old healed fracture or fractures of the ribs or clavicle, which will sometimes be found where there is no recalled history of previous diagnosis of fracture or treatment for such an injury.

Localized deformities and thickenings characteristic of old healed fracture of one or more ribs have been found in the usual areas of rib fracture; namely, in the region of the angle or in the axillary portion. Some patients are in the higher age groups, and it is possible that the absence of a history of injury may be merely a matter of failing memory; in a larger number we believe that it is simply a case of a rib fracture having occurred (the same holds true for the clavicle or sternum, though less frequently), which was evaluated by the



Fig. 5. Case 5: Previously unrecognized fracture of the manubrium. The patient had sustained a compression fracture of the 4th dorsal vertebra upon which clinical interest was centered.

patient or his parents as being not sufficiently serious to warrant medical attention and diagnosis. As previously stated, we recommend that all patients with chest injuries which for medicolegal or other reasons are considered sufficiently important to justify x-ray examination, be given the benefit not only of regional study of the ribs suspected of fracture, but also of at least a single teleroentgenogram of the entire thorax, as a matter of record in the event of a subsequent claim for the activation or aggravation of intrathoracic disease.

CASE 1 (Fig. 1): *Old healed fracture of 11th rib (arrows) and fresh fracture of 10th rib (circled) posteriorly.* One day prior to x-ray study the patient, aged 44, pulled over a barrel and fell against a crate. Former rib injuries were stoutly denied. When did the 11th rib fracture occur? Obviously *not* as a result of this recent injury, but certainly as a result of some earlier unrecalled trauma, perhaps in childhood.

CASE 2 (Fig. 2): *Old, unrecalled, undiagnosed fractures of left 6th and 7th ribs.* Figure 2 is a pre-employment chest film of an industrial worker aged

62. The only recalled injury was a smashed right thumb twenty years earlier. There had been no previous x-ray examination of the chest.

CASE 3 (Fig. 3): *Recent healed fracture of 8th rib, with no admitted history of injury.* A foundry employee, aged 48, had serial x-ray examinations of the chest during exposure to dust as a chipper and grinder. Figure 3A, taken July 29, 1939, shows a normal thoracic cage. Figure 3B, taken March 3, 1941, shows a healed fracture of the right 8th rib

of less than two years' duration. Yet the obtainable history is inconsistent with the positive x-ray findings, and in the light of "objective evidence" it must be adjudged misleading and unreliable.

CASE 4 (Fig. 4): *Recent, previously unrecognized fracture of uppermost segment of the body of the sternum.* A 13-year-old boy had a chest examination



Fig. 6. Case 6: Old, previously undiagnosed fracture of the carpal scaphoid. "Sprain" of wrist 30 years ago. No previous roentgen study.

posteriorly, near the angle, with a trace of downward displacement of the anterior fragment. No history of injury to the chest wall, recalled or admitted by the claimant (who had silicotic fibrosis), was obtained by several medical examiners in preparation for an industrial commission hearing.

*Comment on Case 3:* This case is an instance where serial x-ray studies proved that the injury causing the rib fracture was

because of a small lump in the left breast, near the nipple. A lateral film taken routinely revealed a slightly depressed greenstick fracture of the upper sternum. A "retake" history disclosed a gymnasium injury five weeks previously, when the patient dropped from parallel bars. No blow to the chest wall over the sternum was recalled (instance of fracture as a result of involuntary deep "breath-catching"?). Re-examination four months later (Fig. 4B) showed the fracture of the sternum (not

suspected or clinically diagnosed prior to x-ray study) to be completely healed, proving its occurrence to have been shortly before the original x-ray study.

CASE 5 (Fig. 5): *Previously unrecognized healing fracture of the manubrium.* The patient, about four weeks previously, had fallen down the cellar stairs, injuring the upper spine. The head and neck were carried sharply forward, and a fracture of the spine in the upper dorsal region was suspected. X-ray examination showed a compression fracture of the 4th dorsal vertebra plus an undiagnosed fracture of the manubrium, with overriding of the fragments.

*Comment on Case 5:* This is an example of one fracture producing gross deformity, evident on physical examination, leading the attention away from a second fracture causing little or no deformity.

#### OLD UPPER EXTREMITY INJURIES

Undoubtedly the most important and most frequent fracture in the upper extremity—from the standpoint of the loss of function—to go unrecognized for years and to show lack of correlation of x-ray findings and an adequate history of previous injury dating sufficiently far back, is that of the carpal scaphoid or navicular bone. In our experience, which includes both hospital and private practice and a fair amount of consultation work on cases which have been studied roentgenologically elsewhere, about three old scaphoid fractures (a majority of these being previously undiagnosed) are seen to every fresh scaphoid fracture. Unquestionably it would help the average examiner caring for industrial injuries if every x-ray study of the wrist made following recent trauma included one or two special views taken for the primary purpose of ruling out scaphoid fracture. A postero-anterior oblique view with the radius away from the film and a direct postero-anterior projection with the wrist in acute dorsiflexion are the most useful special positions.

It was our impression for a long time that the reason for lack of correlation between the clinical history of wrist injury and the x-ray evidence of an old carpal scaphoid fracture lay in the long interval between the occurrence of the original

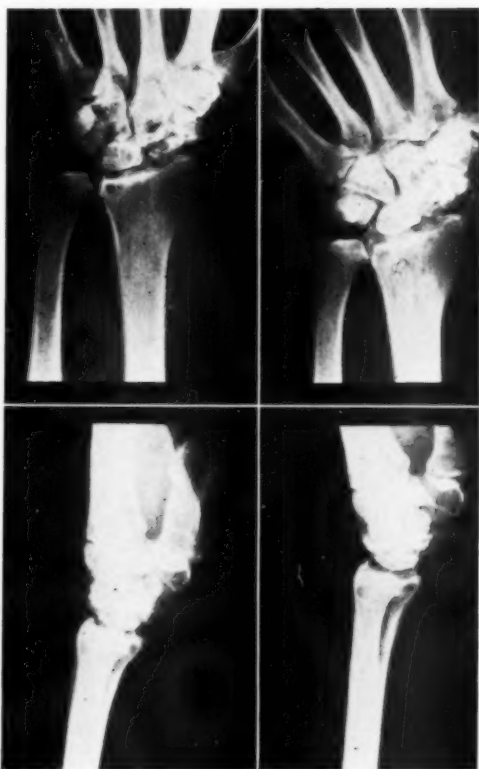


Fig. 7. Case 7: Old, unrecognized, previously undiagnosed scaphoid fracture. History of recent blow to wrist by machine hammer and similar injury six months previously. Marked changes in radius and carpus favor some more ancient trauma as the cause; no such injury recalled by patient.

trauma and the roentgen examination leading to the eventual diagnosis of old ununited fracture. Recently, however, we have had an experience which suggests rather that the unspectacular nature of the accident and the lack of severe symptoms immediately following, are probably equally important factors. The case in mind is that of a boy, aged 12, who sustained a minor injury to the right wrist. In the process of exactly evaluating the fracture of the distal diaphysis of the radius, studies of the left wrist were made, showing an old ununited fracture of the left carpal scaphoid. The boy participated almost constantly in athletics, but he could recall no injury to the left wrist of severity equal to that sustained by the

right one just prior to our study. The possibility of a developmental anomaly (bipartite scaphoid) was carefully considered, since at the time of initial radiography there seemed to be no restriction of motion or weakness of muscle power in the left wrist. A year and a half later, however, on recheck examination, evidence of some post-traumatic arthritis had already de-

veloped, though it is probably attributable to a childhood injury, an avulsion of the olecranon epiphysis, which passes unexamined and undiagnosed. We have seen at least one case of this condition with absolutely no recalled history of old injury to the elbow to permit estimating the approximate date of development of the abnormality. In each of 3 other cases



Fig. 8. Case 8: Old, ununited, previously undiagnosed scaphoid fracture and minimal fresh fracture on lateral aspect of radius. Old injury denied.

veloped; the patient was himself now aware of restricted motion in the part (discomfort in this wrist on doing "hand-stands"), and there was easily determinable limitation of motion, particularly dorsiflexion and volar flexion.

The rather rare patella cubiti, in the majority of instances reported in the literature and likewise in our experience (1), is seldom presented for diagnosis prior to

which we have had an opportunity to study there was a history of childhood trauma, although not always with a clinical or radiologic diagnosis of avulsion of the olecranon epiphysis.

Not so very rarely we have encountered very obvious old healed fractures of one or another of the metacarpal bones or of a phalanx, in which no old injury to the hand or finger was recalled by the patient.

We have likewise seen at least one instance of deformity and lack of complete development of both the radius and the ulna, best explained on the basis of an injury at or near the epiphyseal cartilages in early childhood, in which no such injury was recalled. The only awareness which this patient had of his abnormality was due to restricted motion without muscular weak-



Fig. 9A. Case 9: Old, unrecognized, previously undiagnosed fracture of scaphoid in athletic boy, who recalled no injury. Recent trauma to opposite (left) wrist only.

ness in the wrist joint and the necessity of having the sleeve shortened approximately two inches on the affected side whenever a suit or overcoat was purchased.

CASE 6 (Fig. 6): *Old, ununited, previously unrecognized navicular (scaphoid) fracture.* A man, aged 58, slipped and fell while at work. He recalled a "sprain" of the same part thirty years earlier. No x-ray examination had been made on that occasion (1913).

CASE 7 (Fig. 7): *Old, unrecognized, previously undiagnosed navicular (scaphoid) fracture.* A millwright, aged 57, had his wrist struck nine days previously by a machine hammer. He had suffered a similar accident six months before, of about the same



Fig. 9B. Case 9: Film made a year and a half after 9A, showing slight hypertrophic spurring on scaphoid and radial styloid.

severity, but recalled no earlier injury. Marked nutritional changes in the navicular fragments and adjacent carpal bones and changes in the lower end of the radius almost certainly date back more than six months, to some unrecalled trauma.

CASE 8 (Fig. 8): *Old, ununited, previously undiagnosed navicular (scaphoid) fracture; old trauma denied.* A patient, aged 35, gave a history of recently jerking and striking the wrist while passing through a door. The roentgenogram showed a minimal fresh cortical fracture (arrows) on the posterolateral aspect of the base of the radial styloid; also old spurring at the radial styloid tip and posterior aspect of the navicular.

CASE 9 (Fig. 9): *Old, unrecognized, previously undiagnosed navicular fracture.* The patient, aged 13 when first seen, was examined for recent trauma to the left wrist and a minimal fracture just above the epiphyseal cartilage was demonstrated. The right wrist was examined for purposes of comparison, and an old scaphoid fracture was discovered. It is to be emphasized that this child was unable to recall when this fracture occurred. As this was not an industrial accident and compensation was not involved, there was no reason for willful "forgetting."

A serial film made one and a half years after the



first study is reproduced in Figure 9B. The boy is now beginning to show some of the clinical evidences of a chronic wrist lesion; motion is moderately restricted, particularly dorsiflexion (does "hand-stands" with difficulty, notices pain when throwing baseball hard). Slight hypertrophic changes are developing on the tip of the radial styloid and distal fragment of the navicular.

#### OLD LOWER EXTREMITY INJURIES

In our experience fractures of the lower extremity which have escaped diagnosis because of lack of adequate medical examination, or absence of pain of sufficient intensity or duration to demand medical



Fig. 10A. Case 10: Old, previously undiagnosed fractures of distal radius and ulnar styloid. No old injury recalled.

CASE 10 (Figs. 10A and 10B): *Old, previously undiagnosed fracture of distal right radius and ulnar styloid.* A patient, aged 36, struck his hand on a machine. No previous injury was recalled. In view of 1 1/2 inch shortening of the radius and 1/2 inch shortening of the ulna as compared with the other arm, it is probable that there had been an injury in early childhood, resulting in nutritional disturbances to the epiphyseal cartilages. Prominence of the ulna in the right wrist had been recognized since the age of twenty.

care at all, are (1) those occurring near the upper and lower ends of the fibula, (2) metatarsal fractures, and (3) phalangeal fractures. It is easy to understand the relative lack of pain in fractures of the upper or lower ends of the shaft of the fibula and in fractures of a single metatarsal bone, because of the splinting effect of the other bones present at the same level.

We have seen fractures of the phalanges of the foot missed occasionally, even by the experienced industrial surgeon who sees finger and toe injuries rather frequently. Occasionally, the limited amount of swelling and pain tends to suggest strongly that

possibility of such an occurrence. In these cases, unless the clinical complaints or objective findings are sufficiently positive to indicate the necessity for radiographic study, the fracture may be missed. We recall one case in a man of about 55, an in-

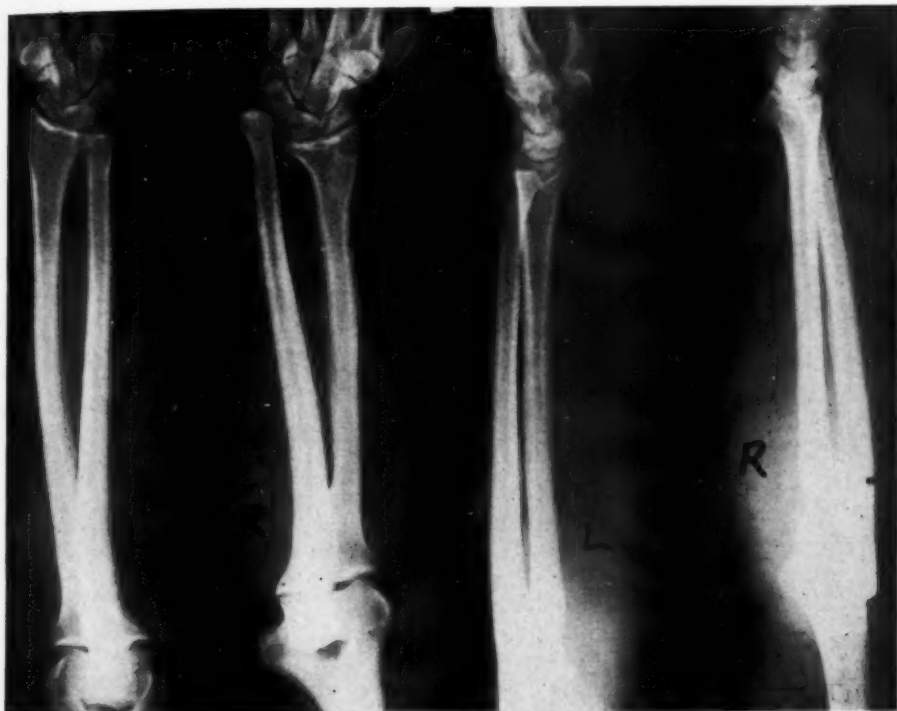


Fig. 10B. Case 10: Shortening of right radius (1 1/2 inches) and ulna (1/2 inch) as compared with opposite arm, due presumably to injury in early childhood, involving epiphyseal cartilages.

no fracture has occurred, and only when some later injury to the same area occurs will evidence of the old, undiagnosed, clinically unsuspected fracture be found. We have observed fractures of the metatarsals and of the fibula in which the roentgen evidence has been quite typical; yet the patient was unable to recall any past injury at either of these levels. In some of these cases medicolegal considerations played no part; hence they cannot be explained on the basis of willful "forgetting."

Occasionally one will encounter a fracture though the nature of the injury would almost positively argue against the

dustrial employee, who came to the clinic complaining of pain in the hip region. He walked with a limp, requiring the use of canes or a crutch. The only admitted injury was a twisting, lifting strain from which, one would ordinarily conclude, a transcervical fracture in a normal bone structure could not occur. Radiographic examination, however, disclosed such a fracture, not markedly impacted, yet holding sufficiently to permit some limited weight-bearing. The patient remained ambulatory for a period of several weeks until, despite the history, which seemed rather conclusively to negate the idea of

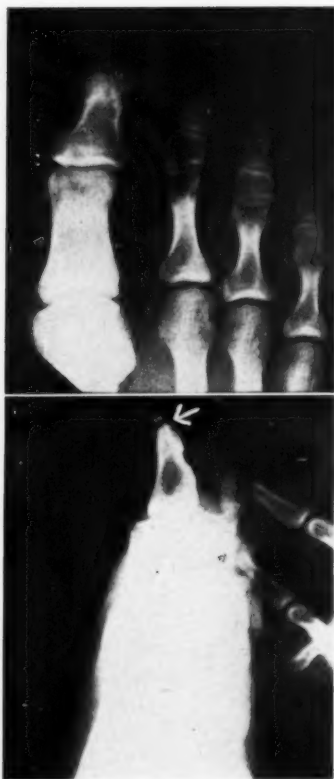


Fig. 11. Case 11: Old, ununited, previously undiagnosed fracture of tip of distal phalanx. The patient had recently dropped a heavy object on the toes. A similar accident had occurred eight months earlier but no x-ray examination was done.

femoral fracture, it was decided to carry out a radiographic study. This revealed a fracture of the femoral neck.

CASE 11 (Fig. 11): *Old, ununited, previously undiagnosed fracture of the distal end of the distal phalanx of the great toe.* The patient, aged 32, had recently dropped an object on the foot. A similar accident to the same part occurred eight months earlier. This had received the usual medical care except that no x-ray examination was done.

CASE 12 (Fig. 12): *Old, healed, previously undiagnosed fracture of proximal phalanx of middle finger.* Three days before examination, the patient, aged 47, had smashed the finger while at work. Previous injury to the part was denied.

CASE 13 (Fig. 13): *Old, previously undiagnosed fracture of lower end of fibular shaft.* The patient, aged 50, had recently "twisted" the ankle. There was no fresh fracture. A retake history disclosed a

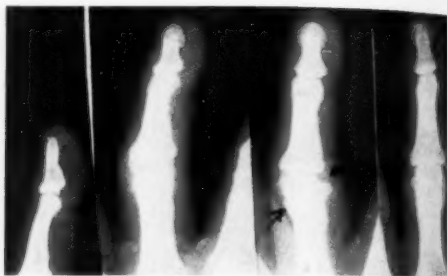


Fig. 12. Case 12: Old, unrecalled, healed fracture of proximal phalanx. The patient smashed the finger three days before examination, but denied previous injury to this part.

fall on the ice two years previously. The patient had received no medical care at that time; only self-treatment for "sprain."

CASE 14 (Fig. 14): *Old, healed, previously unrecognized, undiagnosed 5th metatarsal fracture (arrow).* This 38-year-old patient dropped a casting on his foot. In a "retake" history, he recalled stubbing the little-toe side of the foot twelve years earlier. He saw no doctor at that time, and no x-ray examination was made previous to the present study.

CASE 15 (Fig. 15): *Old, healed, previously undiagnosed fracture (or fractures?) of proximal shaft of the 2d and probably proximal shaft of the 3d metatarsal; old bowing deformity of the 2d metatarsal (arrows).* The patient, aged 63, dropped a heavy object on the foot, causing fresh fractures of the proximal shafts of the 1st and 2d metatarsals (circled). No previous injury was recalled.

CASE 16 (Fig. 16): *Old, healed fracture of left calcaneus; original history negative for old injury.* The patient, aged 57, received a recent twisting injury to the left ankle. A "retake" history elicited recollection of a fall from a roof at the age of 18. The patient saw a "bone-setter" (not a physician) and following manipulation continued to walk on the injured part, returning to carpentry work after a six-day lay off.

#### SPINE, SKULL, AND PELVIS INJURIES

Certainly it is hard to think of a person having a major fracture of the spine or pelvis and doing well when the diagnosis of fracture is missed and proper treatment is not promptly instituted. Nevertheless, one occasionally encounters such a situation, particularly if some other condition, such as a leg fracture requiring a period of bed rest, has resulted from the same injury. It is our impression that in older people who are not too inactive but are engaging in no heavy manual labor or other strenu-

ous physical activity, a mild compression fracture of a vertebra may be followed by satisfactory clinical recovery with no marked "kummelling," despite the omission of reduction, plaster fixation, or brace fitting. That anyone could sustain a severe compression fracture of the spine with associated luxation, have symptoms for only a few days, and go a period of fifteen years before even having an x-ray study,

nitely, except that a second trauma to the same side of the pelvis, eight months after the original injury, caused a subcapital fracture of the femur which necessitated hospitalization and x-ray study. This showed both the recent femoral fracture and the old healed fracture of the ilium with exuberant callus, which until that time had been accepted as a "contusion" and so treated.



Fig. 13. Case 13: Old, healed, previously undiagnosed fracture of lower end of shaft of fibula. History of fall two years earlier, with self-treatment for "sprain."

seems most unlikely; yet such was the situation in one of the cases reported here (Case 18).

Fractures of the pelvis are seen oftenest as the result of major crushing or squeezing trauma and only rarely go clinically unsuspected or radiographically unstudied. One such case was seen, however—a long vertical fracture through the lateral aspect of the ilium, which went eight months undiagnosed. It might have gone so indefi-

Similarly it is seldom that we have found any appearance in the skull bones strongly suggestive of old fracture without a history of previous injury and clinical and x-ray diagnosis of fracture. A hospitalized patient was recently seen, however, who had sustained a concussion, together with a long laceration involving the right side of the forehead, in whom the radiographic appearances of the left side of the face were considered almost positively indica-

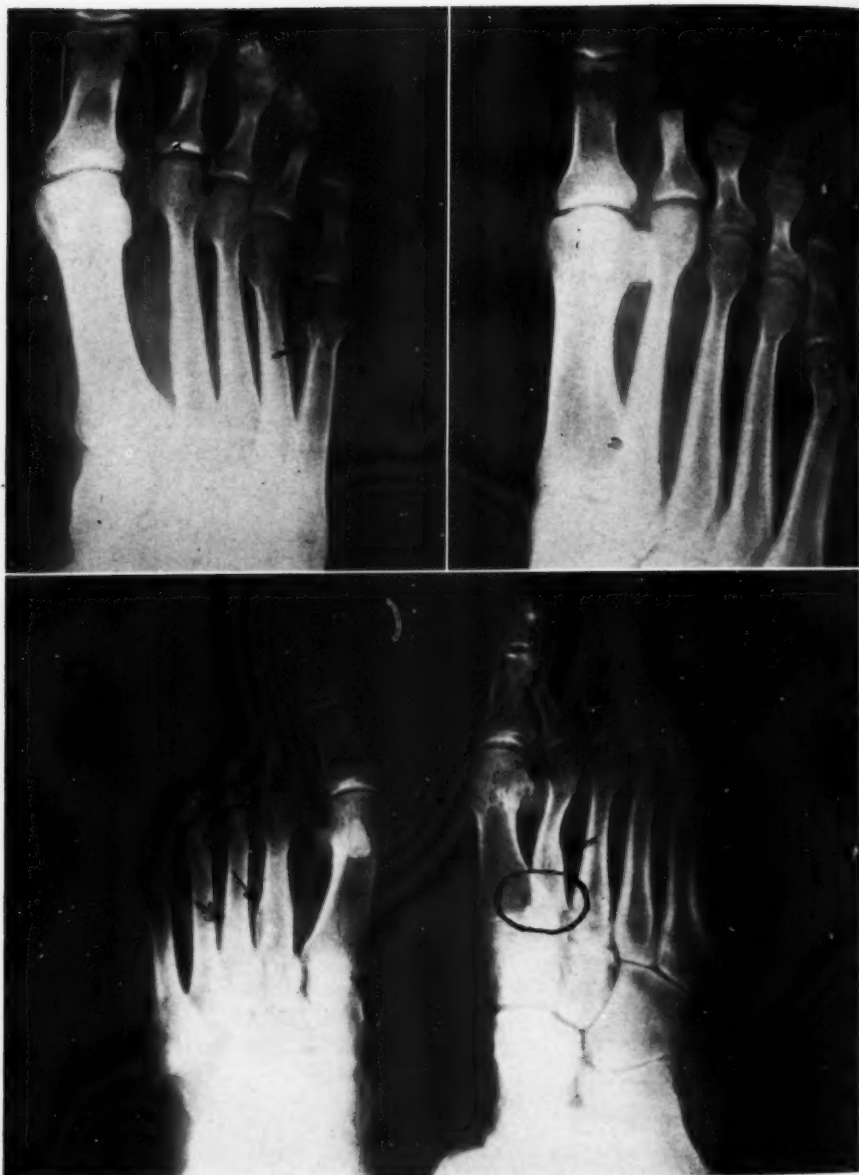


Fig. 14. Case 14: Old, healed, previously unrecognized fracture of distal shaft of little toe metatarsal bone. The patient recently dropped a casting on the foot; recalled stubbing little toe twelve years earlier. No x-ray examination then.

Fig. 15. Case 15: Old, unrecalled, previously undiagnosed fracture(?) 2d and 3d metatarsals (arrows); fresh fractures 1st and 2d metatarsals (circled). No previous injury to foot recalled.



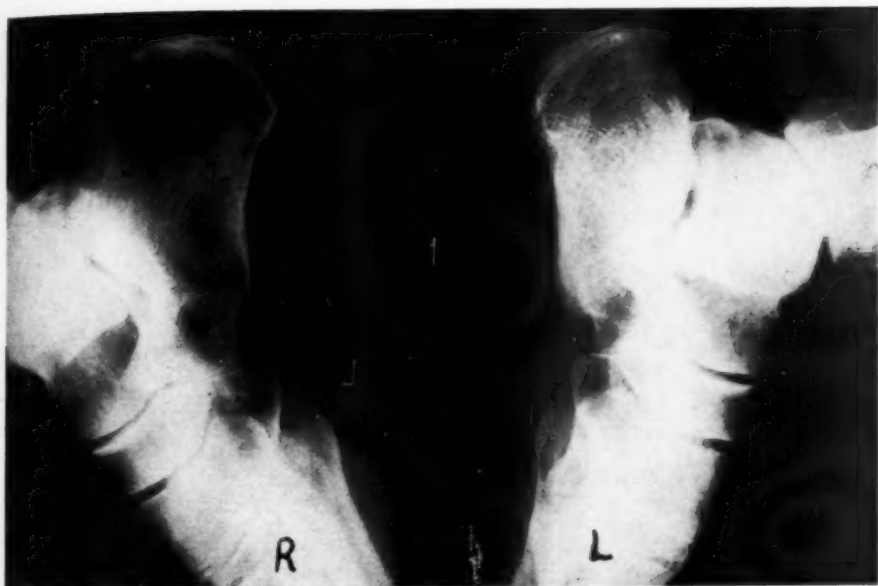


Fig. 16. Case 16: Old, healed fracture of left os calcis. Original history negative for old trauma. "Retake" history elicited recollection of fall from roof at age of eighteen (thirty-nine years earlier), treated by "bone-setter."

tive of an old healed fracture of the zygomatic process of the temporal bone. There was no tenderness or swelling over this area, and careful questioning in the "re-take history" to supplement the one already recorded by the intern elicited no recollection of old trauma at this level.

CASE 17 (Fig. 17): *Previously undiagnosed fracture of 10th dorsal vertebra.* A woman, aged 77, fell backward in the bathtub eight months before being examined roentgenographically. A substitute for her regular family physician taped her back and kept her in bed for two weeks. No further treatment was given. Recently she had experienced slight discomfort on forward bending but protested that there was no need for x-ray study. She had no further treatment following roentgen examination and recently stood a long auto trip with no apparent bad effects. This patient has now been observed for more than a year following the x-ray examination and continues free of symptoms and as active as prior to the fall.

CASE 18 (Fig. 18): *Previously undiagnosed severe compression fracture of the 12th dorsal with luxations between the 11th and 12th dorsal and 1st and 2d lumbar vertebrae.* A man of 36, about to be called for the draft, complained of upper lumbar backache for a few months only. He recalled a back injury at the age of 21, when he was thrown from a car. His back ached for three or four days, but he saw no



Fig. 17. Case 17: Old, previously undiagnosed fracture of 10th dorsal vertebra. The patient, aged 77, fell backward in bathtub eight months earlier and was treated by two weeks' bed rest and taping. Slight pain on forward bending.



Fig. 18. Case 18: Old, previously undiagnosed fracture luxation of dorsolumbar spine. Auto injury fifteen years previously; no physician's care; no previous x-ray study. Recurrence of symptoms.

physician. He participated in sports, such as basketball and baseball, both previous to and following the accident. The roentgenogram shows marked thinning of the 11th dorsal disk and calcification in the anterior longitudinal ligament between the 1st and 2d lumbar bodies and posteriorly in the interspinous ligament.

CASE 19 (Fig. 19): *Old, healed fracture of lateral aspect of ilium with exuberant callus, occurring in all probability eight months previously.* This patient sustained a recent injury to the pelvis, resulting in a subcapital fracture of the femur. This was the second injury at this site, but there had been no diagnosis of fracture and no previous x-ray examination. The patient was known to be syphilitic and had received treatment several years previously for Charcot's knee in the same leg.

CASE 20 (Fig. 20): *Old, healed fracture of left zygomatic arch with depressed deformity.* A patient, aged 53, sustained a recent concussion and laceration in the right supraorbital region. There was no evidence of recent bony or soft-tissue injury of the left side of the face, and no old injury to the head was recalled (? residual of fist fight in childhood).

## CONCLUSIONS

Roentgen evidence has been obtained of old healed fractures, involving every major part of the skeleton, which had gone unstudied radiographically and undiagnosed clinically from a few months to a number of years. In some cases a second injury to the same area led to the x-ray study which finally revealed the ancient fracture. At



Fig. 19. Case 19: Old, healed fracture on lateral aspect of ilium, with exuberant callus in a patient known to be syphilitic. Recent subcapital fracture of femur required hospitalization. Patient fell eight months previously, injuring same hip region; diagnosed "contusion"; no x-ray study.

other times a routine pre-employment examination of the chest or a radiographic study for some reason other than further injury permitted recognition of the previously missed fracture.

Of considerable interest and importance to the physician testifying in medicolegal cases is the complete failure of many of these patients to recall any old injury. Under such circumstances, we contend that, if the roentgenologic criteria of old fractures are positive, the x-ray evidence

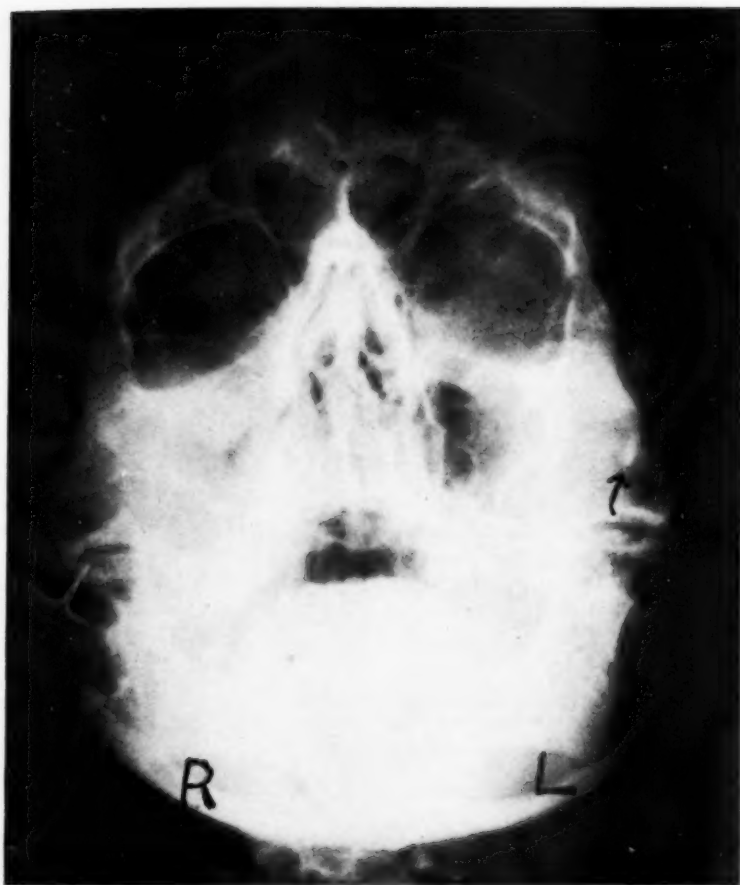


Fig. 20 Case 20: Old, healed, unrecalled depressed fracture of zygomatic arch. Recent laceration of opposite frontal region. No earlier injury recalled.

must be accepted at its full value, despite its apparent contradiction of the history.

It appears justifiable to conclude that fractures occasionally occur under such circumstances as to permit the condition to be: (1) undiagnosed, (2) untreated, or at least inadequately and unorthodoxly treated, and (3) ultimately forgotten.

Probably the commonest site of fractures undiagnosed, untreated, and ultimately forgotten, is the ribs. Usually no particular harm (dysfunction or increasing pain) results. The fracture which is perhaps of greatest importance as a source of increasing pain and dysfunction, though the original injury may be completely forgotten and there may have been no examination

or diagnosis, is that of the carpal scaphoid. Radiography in at least three positions in every case of wrist trauma would unquestionably reduce the incidence of missed diagnoses of carpal scaphoid fractures.

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## The Induction Film as an Aid in Appraising Subsequent Pulmonary Lesions<sup>1</sup>

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THE IMPORTANT problem of tuberculosis in the Army is the discovery of the minimal lesion that exists without symptoms. This problem has long been recognized and was especially emphasized by experience in the first World War (1, 2, 3). The Selective Service Act which was passed by the Congress of the United States in September 1940, therefore, not only required the registration of all young adults for military service, but with its passage the Mobilization Regulations 1-9 as of Aug. 31, 1940, were put into effect. Upon the recommendation of a subcommittee on tuberculosis of the General Committee on Medicine of the National Research Council, these regulations required that every potential soldier be completely examined. This examination included a thorough physical check-up, and an x-ray study of the chest was recommended. Although the regulations then did not require chest roentgenography as a routine part of the examination of the inductee, they did define in detail the general character of minimal or arrested lesions demonstrable by x-ray that would be permissible under Class 1-a.

On Oct. 28, 1940, a directive from the Adjutant General's Office of the United States Army provided an opportunity for local agencies to set up and operate roentgenographic services for inducted men. These agencies were to be compensated by the Government until such time as the Army could assemble its equipment and take over the responsibility (4). After Jan. 1, 1941, the Army assumed the full responsibility for roentgen-ray service in induction centers (4). The Surgeon General's office then indicated that the Army was committed to routine roentgen examination of all recruits at induction centers. Paragraph 51, Section XIII, MR

1-9 states: "The chest examination will include a roentgenogram, as well as the usual methods of physical diagnosis. A pertinent history of past chest diseases will be taken. Because of its importance and frequency, special consideration must be given to the detection of tuberculosis" (5).

At no time in the history of any country has there been such a definite program requiring examination of all young, supposedly healthy males for the exclusion of one specific disease. Small and isolated communities have promoted such programs to demonstrate methods for the control of pulmonary tuberculosis but, except for their individual findings, these programs were of little value except to stress the fact that routine x-ray studies of the chest were of the greatest importance.

The best way to detect latent chest lesions is by roentgen examination. At least 75 per cent of early active tuberculosis can be discovered only by this means (3). About 1 per cent of the male population of military age has active tuberculosis, most of which can be detected only by x-ray examination (3). Chest surveys of military personnel are not new. Richards (7), reporting on 328,325 men examined for the Canadian Army, stated that 3,076, or 0.9 per cent, were rejected because of pulmonary tuberculosis. Edwards and Ehrlich (4) found that of 50,000 inductees and National Guardsmen, between 1.2 and 1.36 per cent were rejected for the disease. Plunkett (8) reported on 14,923 men, of whom 127, or 0.86 per cent, were similarly disqualified for military service. Levitin (9) found that between 1.2 and 1.35 per cent of the healthy male population had reinfection tuberculosis. Ashbury and his associates (10, 11), reporting on examinations made at United States Army Induction Station No. 6, Third Corps Area, stated that 1.2 per

<sup>1</sup> Accepted for publication in March 1944.

cent of 11,685 inductees and 1.3 per cent of 22,054 inductees had disqualifying lesions. All agreed that group surveys of the chest by roentgen examination were satisfactory and that the results justified the work and the expense involved. The Government, by the requirements of the Selective Service Act, has definitely aided in the fight against pulmonary tuberculosis.

It is difficult to realize that 7,000,000 chest roentgenograms have been taken and filed and that an army of young adults has been studied by this procedure. Not included in this figure is that large group which has been rejected for disabilities other than pulmonary. In addition, the personnel of the integrated forces—Navy, Marines, Coast Guard, Women's Army Corps, etc.—have had similar examinations.

All films made at the time of induction are filed either with the Veterans Bureau (for those accepted) or with the State Director of Selective Service (for those rejected) (12). In this way, there is furnished a permanent and authoritative record which may be useful in subsequent medical study or medicolegal adjustment. The films are obtainable at the request of hospital or medical authorities. If a lesion is found in a subsequent examination, a comparison can be made with the induction film, which is of the greatest aid in determining the activity or stability of the process and whether it is a recent or old one. It is an appreciation of this progressive program and an appraisal of some of its benefits that furnish the basis of this paper.

#### CLASSIFICATION OF LESIONS

One of the first problems considered by the subcommittee on tuberculosis of the National Research Council was the terminology to be employed in the Army Manual as related to pulmonary and other chest diseases. Certain revisions were recommended and accepted and were incorporated in the Mobilization Regulations 1-9, Aug. 31, 1940. These were subsequently superseded by MR 1-9, March 15, 1942, later by MR 1-9, Oct. 15, 1942, and then by MR 1-9, C 1, Jan. 22, 1943. In re-

gard to pulmonary tuberculosis, the following recommendations were made (12).

#### *"Acceptable:*

"56 f. Healed intrathoracic primary tuberculous lesions, demonstrable in roentgenograms, but of slight extent. The following specifications of the limits of such lesions are intended to exclude persons with disease which is most likely to be in part caseous and therefore potentially hazardous. The limits are set arbitrarily to provide an objective basis on which the examiner may render a decision. All measurements refer to single, standard 14- by 17-inch direct projection roentgenograms. These lesions may consist of

"(1) Calcified residues of lesions of the intrathoracic lymph nodes, provided none of these exceeds an arbitrary limit of 1.5 cm. in diameter and the total number of such lesions does not exceed five.

"(2) Calcified lesions of the pulmonary parenchyma, provided the total number of these does not exceed ten. One of these may equal but not exceed 1 cm. in diameter, but none of the remainder may exceed 0.5 cm. in diameter. In the roentgenogram such calcified lesions should appear isolated, sharply circumscribed, homogeneous, and dense.

"The above arbitrary limits of calcified lesions are set on the assumption that large and numerous lesions are more likely to be partially unhealed, and therefore a potential source of future recrudescence than small lesions of limited distribution. It is recognized, however, that in some individuals calcified tuberculous lesions exceeding these limits may be present which are so well healed that the possibility of future reactivation is remote. Further consideration may be given to the acceptability of persons with calcified lesions of this type when the state of health in all other respects clearly warrants the opinion that the lesions in question are healed. In such cases the history of the applicant and his age, as well as the character of the lesions as seen in x-ray films, provide criteria for estimating the probability of complete arrest of the tuberculous process. If there is no history of active tuberculosis or symptoms which might be interpreted as evidence of this disease and if the applicant is more than twenty-five years of age, and if finally the calcified lesions seen are dense and discrete in character and not hazy or irregular in outline, such lesions may be considered as not prejudicial to future health. In these cases the applicant may be accepted provided the report of physical examination and the chest x-ray films have been reviewed and acceptance has been recommended by a medical examiner specially qualified in the diagnosis of diseases of the chest.

*"Nonacceptable:* Disqualifying defects such as

"(a) Tuberculosis of the lungs or tracheobronchial lymph nodes except as defined in paragraph 56 f and b below.



"(b) Scarred infiltrative tuberculous lesions of the lungs, except that small fibroid or calcified lesions represented in roentgenograms as sharply demarcated strand-like or well defined, small, nodular shadows not exceeding a total area of 5 square cm. may be accepted after deferment until subsequent examination demonstrates that the lesion is stationary and not likely to be reactivated. The minimum period of time to determine this is six months. It must be recognized that either progression or regression of the lesion indicates instability. Clinical judgment, taking into consideration other factors, including age and race, must be exercised in estimating the likelihood of reactivation. Experience indicates a greater likelihood of reactivation of a lesion that appears to be stable in persons under twenty-five years of age than in older persons."

All soldiers, however, cannot be considered healthy and completely free of pulmonary conditions. A small percentage with pulmonary lesions were acceptable under the specifications of MR 1-9. In attempting to retain certain valuable men in the service, the regulation had to be broadly interpreted, for although a lesion may be discrete, have definite borders, and appear inactive, it is well known that activity cannot always be determined by one or even several x-ray examinations. Hospital observation is necessary. Kruger, Potter, and Jaffin (13), in agreement with Amberson (14), have shown that it is hazardous in many cases to attempt to decide whether a particular lesion is active or arrested, on the basis of a single examination. Only by serial films over a definite length of time can this question be solved.

It is also well known that under the conditions of civilian life a discrete minimal lesion may undergo no change and can therefore be considered "inactive." In Army life, however, fatigue, worry, lowered resistance, and irregular hours incident to training or combat can readily activate these latent foci so that the subject actually becomes a casualty and a burden to the government for the rest of his life. Richards (7), reporting on chest roentgen examinations in the Canadian Army, stated that 9 cases out of 328,325 broke down under military service. It must be added, however, that on the initial roentgen examination these cases were

reported as "doubtful" but "fit for service." This figure is small and may be insignificant statistically, but is indicative of the caution that must be exercised with roentgen examination.

Certain groups of soldiers, also, have been admitted into the Armed Services with pulmonary tuberculosis because of incorrect interpretation of the induction films, either as a result of technical errors, oversight on the part of the examining roentgenologist, or fatigue incident to an unreasonable number of readings at any one time. Richards found 11 cases missed in his series, an error of 0.003 per cent. In each instance, competent men had originally overlooked the lesion and, when the roentgenogram was reviewed, all agreed as to its presence. This percentage is admittedly low, but it must be pointed out that it is based on a review of cases subsequently proved to be pulmonary tuberculosis. The examiners did not know how many cases were missed that failed to become active during military service.

Not only has Army life proved deleterious to minimal lesions, but many roentgenologists in the military service have changed their attitude as regards the minimal fibrotic or fibrocalcific lesion. In civilian life, apical lesions of this character are often assumed to be arrested or inactive. Although they are noted, they are not considered significant. In the military service, however, many such lesions are regarded as active even though arrested. The tendency is to err on the side of safety in the interpretation of the roentgenogram.

#### OBSERVATIONS ON PATIENTS ADMITTED TO HOSPITAL WITH DIAGNOSIS OF TUBERCULOSIS

During the period Jan. 1, 1942, to Jan. 1, 1943, 4,019 patients were admitted to Lovell General Hospital, from station hospitals or overseas bases. Of this number, 122, or 3.03 per cent, were admitted directly to the tuberculosis ward. These represented all cases of either *proved* or *suspected* tuberculosis admitted to the

hospital. In this group there were 14 cases of non-pulmonary tuberculosis. Of the 108 remaining patients, 23, or 21.3 per cent, were admitted solely on the basis of routine x-ray examination of the chest. Eleven cases in this group, to be discussed later, were subsequently proved to be active and serial x-ray studies of the chest showed definite *progression* or *regression* while the patients were under observation. Had these examinations not been made, there is every reason to believe that the patients would not have been hospitalized. The roentgenograms had been taken either at the request of soldiers who had been contacts or during routine examinations for Officers' Candidate School. In each instance the patient was asymptomatic and considered to be in good health. The majority of the remaining patients were admitted because of cough, expectoration, hemoptysis, fever, or weight loss (see Table I).

TABLE I: SYMPTOMS IN 108 CASES OF SUSPECTED OR PROVED PULMONARY TUBERCULOSIS

Cough.....	75 (69.4%)
Expectoration.....	65 (60.1%)
Pain.....	61 (56.5%)
Fatigue.....	46 (42.6%)
Fever.....	45 (41.6%)
Weight loss.....	41 (37.9%)
Hemoptysis.....	35 (32.4%)
Malaise.....	34 (31.5%)
Dyspnea.....	31 (28.3%)
Night sweats.....	29 (26.8%)
Loss of appetite.....	24 (22.2%)
Hoarseness.....	16 (14.8%)
None: Patient hospitalized because of routine x-ray examination of chest.....	23 (21.3%)

It is to be noted that of those having definite complaints, the *initial* symptom was cough in 38 cases; pain in the chest in 11; chills in 5; dyspnea and fatigue in 4 each; weight loss and hemoptysis in 3 each. Many of the patients had experienced symptoms for three or more months before hospitalization.

Of the 108 patients admitted, 75, or 69.4 per cent, were found to have pulmonary tuberculosis; in 46 of these, or 61.4 per cent, the disease was active. The lesions were classified as minimal in 37 cases (49.3 per cent); moderately advanced in 14 cases (18.6 per cent); far

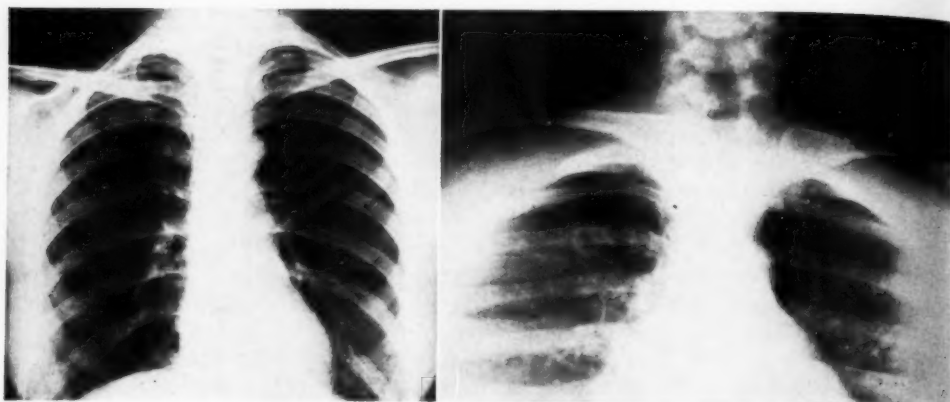
advanced in 24 cases (32.1 per cent). The percentage of minimal cases is higher than is usually reported from tuberculosis sanatoria.<sup>2</sup> This is doubtless to be accounted for by the 23 cases admitted solely on x-ray evidence, in all of which the disease was classed as minimal.

The age period in which the majority of cases was found was twenty-three to twenty-six years. In this group there were 46 cases. The mean age was twenty-four years.

Upon admission, sputum examinations were done in each case. If these proved negative, gastric lavage was done and the washings were tested by guinea-pig inoculation and cultures. The sputum findings were positive in 30 cases. In 7 in which the sputum was negative the findings on guinea-pig inoculation of gastric washings were positive. One patient was admitted in a moribund condition and tubercle bacilli were found in the spinal fluid. In another the urine was found to contain tubercle bacilli. In 7 cases activity was manifested by changes noted on serial x-ray examinations of the lungs. In the latter group of cases, all other studies were negative.

Of the 46 patients with active disease, 24 were enlisted men, the majority of whom were not examined roentgenographically on their entry into the Army. Induction x-ray studies had been made in 22 patients, as required by the Selective Service Act. Of those who had no enlistment x-ray examination, 12 had far advanced lesions, 5 moderately advanced, and 7 minimal. Among those examined roentgenographically at induction, 12 were found to have far advanced disease and 10 had minimal lesions. This is significant for, while numbers in the two groups are small, they are comparable. As will be shown later, in an appreciable number of cases lesions of impressive size were present on induction films. For reasons not understood, these were not noted. These soldiers should never have been inducted. The films, however, served a valuable pur-

<sup>2</sup> About 20 per cent.



Figs. 1 and 2. Case I (asymptomatic): Figure 1 (left) is a routine film of the chest, showing exudative infiltration in the anterior portion of the right first interspace and beneath the right clavicle.

Figure 2 (right) is an anteroposterior lordotic projection, revealing a cavity 8 mm. in diameter. This was not evident in the routine postero-anterior view of the chest.

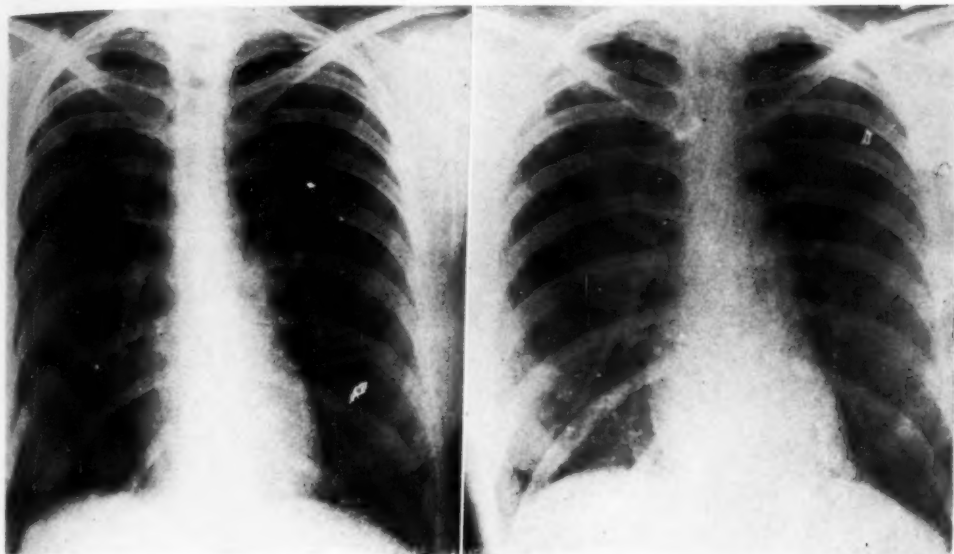
pose, for they assisted enormously in determining the age of the lesion and whether or not activity was present.

The determination of activity, while not difficult in the moderately advanced or far advanced cases, was exceedingly difficult in the minimal lesions, for many of these consisted of small infiltrates either at the extreme apex or periphery of the lungs. In each case, therefore, *all previous films were requested*, either from civilian hospitals, sanatoria, or the Veterans Bureau in Washington. This was done to ascertain definitely the time of the onset of the lesion and to determine whether any changes had occurred. Two enlistees had been treated in sanatoria in civilian life: in one patient the lesion was proved inactive. The second was found to be active, as manifested by a considerable regression.

Among the inductees examined roentgenographically upon their entry into the Army, 19 films were available for comparison. One patient with a negative induction film had pulmonary tuberculosis developing nine months later. *Thirteen patients had demonstrable tuberculous lesions at the time of induction.* Four were "considered acceptable under MR 1-9." *In 2 of these, the lesions were proved to be active and showed progression at the time of hos-*

*pitalization.* The remaining 2 cases had remained stationary. In 9 instances no note was made of the lesion at the time of induction, although it was demonstrable on the x-ray film. Four of these cases showed minimal involvement, but were proved active. One had remained stationary. The remaining 4 were far advanced upon admission, showing marked progression as compared to the condition on induction, which occurred three to five months before hospitalization. In 5 cases induction roentgenograms were not available but the histories revealed previous sanatorium care ranging from nine months to three years in duration. The lesions were verified on films obtained from the sanatoria and it must therefore be inferred that they were present in the induction roentgenograms. In this group, there were 4 with no change. The remaining patient showed definite activation. It is thus apparent that an enormous value is to be attached to the films taken at the beginning of military training. This value, however, is *commensurate with the quality of the photography and the care with which the film is interpreted.* Efficiency of clerical help may also be a factor.

Of the 23 asymptomatic cases admitted to the hospital solely because of findings on a routine x-ray study of the chest, 11



Figs. 3 and 4. Case II. Figure 3 (left), taken upon going on extended active duty, shows bilateral apical infiltration. The lesion in the left apex underlies the third posterior rib. The lesion in the right apex gives the appearance of an obliterated apical cap.

Figure 4 (right), taken Dec. 7, 1942, shows the left apical infiltration unchanged. The exudative lesion, measuring  $2 \times 2$  cm., in the right apex indicates activity when compared with Figure 3.

(47.8 per cent) were proved active. In 6 of these activity could be determined only by serial x-ray examinations. All other laboratory data were persistently negative. Two patients had positive sputum. The remaining 3 active cases were proved active only by positive guinea-pig inoculation, which was confirmed. Twelve cases showed no change in serial x-ray examinations, and the laboratory results and clinical courses were negative.

#### OBSERVATIONS ON PATIENTS ADMITTED WITH NO DIAGNOSIS OF TUBERCULOSIS

In the period under consideration, 3,897 patients were admitted to this hospital for other than tuberculous conditions. On routine x-ray examination of the chest, 26 patients in this group were found to have asymptomatic pulmonary tuberculosis. The lesions were minimal, as manifested by apical infiltrates or areas of definite linear fibrosis. In 2 cases appreciable infiltrates were shown on the induction film and of these one was proved active. The remaining 24 patients in this group were



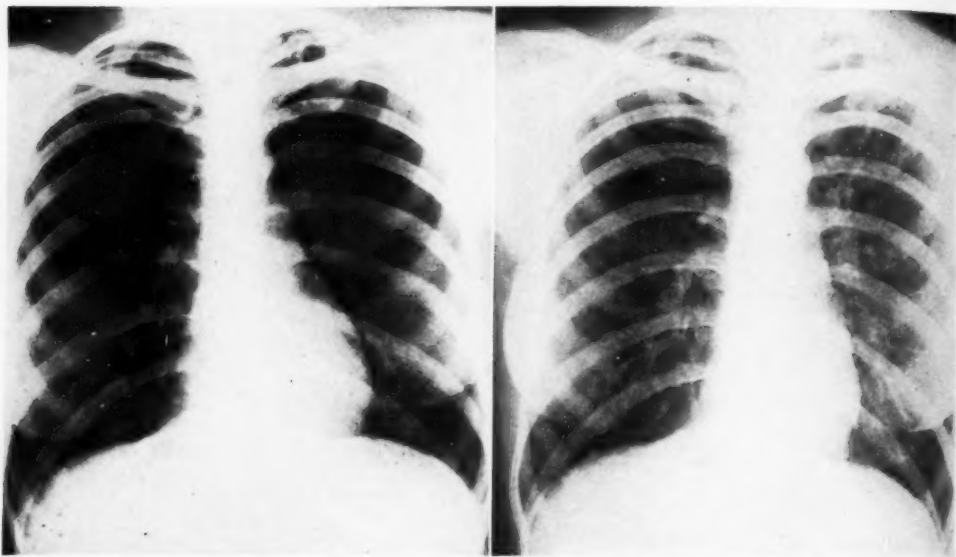
Fig. 5. Case II: Lordotic view showing to better advantage the right apical infiltration seen in Figure 4.

considered as having arrested or inactive lesions, after the necessary clinical observation.

#### OBSERVATIONS FOR ENTIRE GROUP

Altogether, in 21 instances earlier films were obtained for subsequent comparison, and 20 subjects were shown to have had





Figs. 6 and 7. Case III (asymptomatic). Figure 6 (left) is a routine chest film demonstrating calcified infiltrations in the extreme left apex and fibroid infiltrations in the left first anterior interspace.

Figure 7 (right), taken two months after Figure 6, shows increased extent of infiltrations in the left first anterior interspace indicative of activity. The patient was still asymptomatic and the laboratory data were negative.

tuberculosis prior to their entry into the Army. Of 21 cases for which previous x-ray studies were obtainable, 11, or 52 per cent, had been overlooked at induction, due probably to fatigue on the part of the roentgenologist incident to reading an unusually large number of films or to clerical error. Although the percentage of missed cases was higher than that found by Richards (7), it must be pointed out that it was based on a review of those cases which subsequently showed pulmonary tuberculosis, and that only 21 of the 75 cases proved active were reviewed by such a method. Because the number of inductees is not known, the actual percentage of error cannot be estimated. Long and Stearns (6) reviewed 53,400 chest x-ray films representative of men accepted at 89 induction stations in the United States. Among this number they found 271 showing infiltrative lesions, of which 173 were considered to represent inactive tuberculosis. The remaining 98 lesions were significant. It is apparent, therefore, that when facilities are available and the budget permits, all soldiers should have x-ray examination of the

chest on admission, for whatever reason, to a fixed installation.

#### ATYPICAL PNEUMONIAS: DIFFERENTIAL DIAGNOSIS

During the past two years an increasing number of atypical pneumonias have been reported. This is due partly to the increased number of chest roentgenograms taken of patients with respiratory diseases associated with fever. Differential diagnosis is difficult in protracted cases, and prolonged observation is often necessary to rule out pulmonary tuberculosis. In many instances, discrete lesions with well defined borders, having the usual character of a tuberculous infiltrate, have been demonstrated. These lesions resolve slowly, occasionally requiring from two weeks to three or more months for complete disappearance. For that period of time the patient is a tuberculosis suspect. In other cases, x-rays of the chest reveal diffuse lesions having a fibropneumonic appearance; in these, also, prolonged study and hospitalization are necessary to exclude tuberculosis. It is this condition which



accounted for the majority of admissions in our series of 33 cases subsequently proved to be non-tuberculous.

The differentiation between atypical pneumonia and pulmonary tuberculosis is often impossible if only one film of the chest is available. Kneeland and Smetana (15) have reported a case of atypical pneumonia in which the roentgen appearance was so typical of tuberculosis that

lous lesions in the apical area. It is a simple method and one which entails no additional equipment. The technic employed by Major B. Copleman and Captain G. Lavner (17) is a reapplication of the method described by Fleischner (18) and later used by Lindblom (19), who found that the "semi-axial position permitted increased visibility of cavities and other processes in the apices of the lungs"

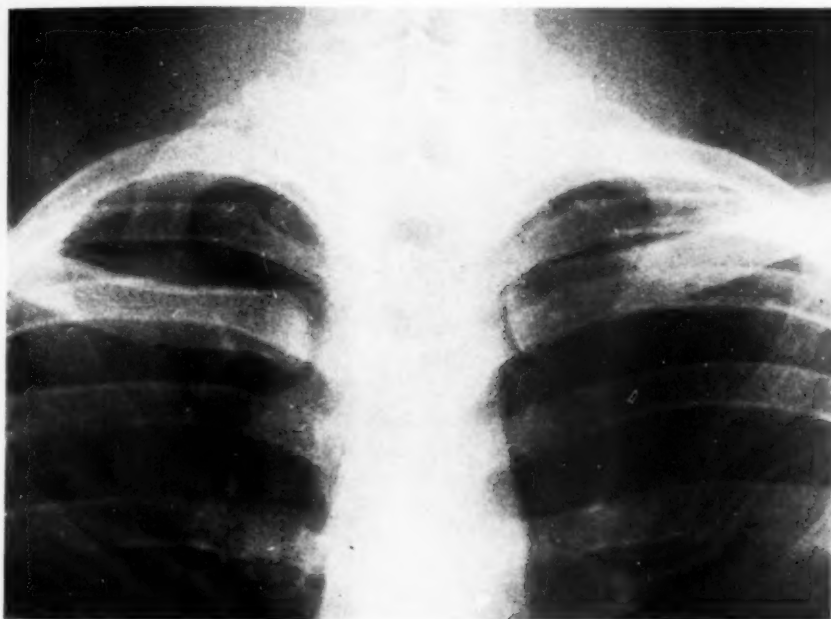


Fig. 8. Case IV (asymptomatic). Routine film of chest, showing exudative lesions underlying the clavicle and first anterior rib. The exudative lesion in the first anterior interspace with central translucency is suggestive of cavity, but subsequent studies revealed no cavitation.

pneumothorax was instituted. Ackermann (16), in order to determine the true nature of the lesions in his series, resorted to serial x-ray studies, "which permitted an exact study of the type of lesion encountered in individual cases, and also its progress, which alone is of decisive importance."

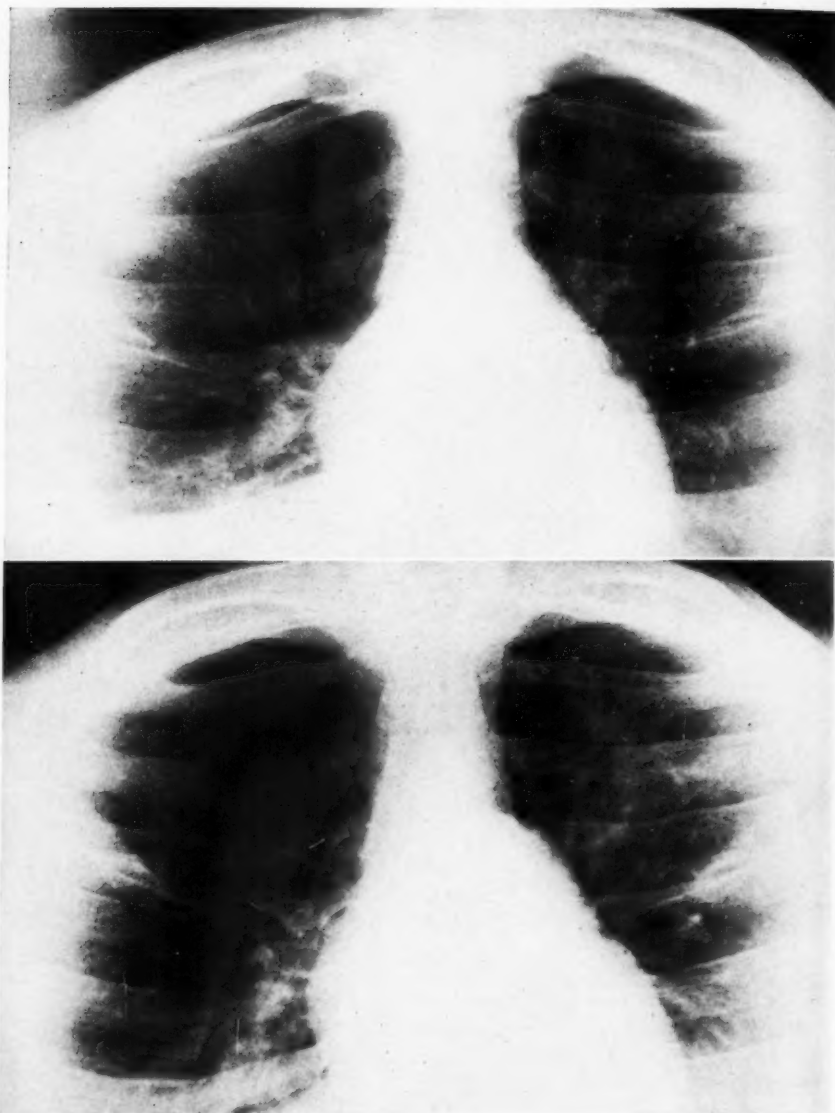
#### ANTEROPOSTERIOR LORDOTIC VIEWS IN THE STUDY OF MINIMAL APICAL LESIONS

Not infrequently, the so-called lordotic view has been found helpful as a means of disclosing hidden or ill-defined tubercu-

(20). The importance of this type of exposure will be evident in certain of the case reports describing apical lesions which were partly obscured by clavicles or thoracic bony structure.

#### CASE REPORTS

CASE I: C. R., aged 33, 2d Lieutenant, A.N.C., had a final type physical examination for extended active duty on Dec. 7, 1942. On March 6, 1943, she reported to this hospital for extended active military service and a routine x-ray film of the chest was made. This revealed mottled parenchymal infiltrations in the right upper lung field in the anterior portion of the first interspace. Fibrotic strands



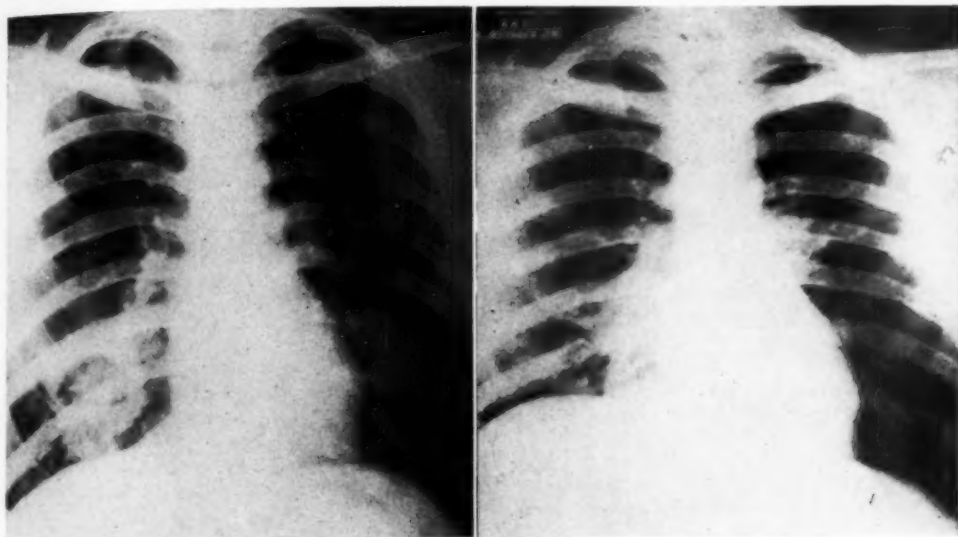
Figs. 9 and 10. Case IV. Figure 9 (above) is a lordotic view disclosing an exudative lesion underlying the first anterior rib and clavicle, as shown also in Figure 8.

Figure 10 (below) is a lordotic view taken six months after that in Figure 9. There is a definite increase in the exudative infiltration, indicative of activity. Routine postero-anterior projections failed to show any change over this period.

extended from the right hilum to this area (Fig. 1). A lordotic view revealed a circular field of increased translucency, approximately 8 mm. in diameter (Fig. 2). This was surrounded by a well defined annular shadow and undoubtedly represented a cavity. There were a few infiltrations in the left apex. Serial x-ray examination showed an increase of the exudative reaction in the right upper lobe.

It is to be noted that physical examination and laboratory data were negative. A roentgenogram of the chest made on Dec. 7, 1942, revealed no pulmonary lesion.

CASE II: C. M., 2d Lieutenant, A.N.C., aged 32, when examined by x-ray thirteen months after entry into the military service, was found to have an area of soft infiltration measuring  $2 \times 2$  cm. in the



Figs. 11 and 12. Case V. Figure 11 (left) is the chest film made in November 1938, showing a 4-cm. cavity in the right lower lobe, surrounded by a moderate zone of reaction. Exudative lesions are seen about the right hemidiaphragm.

Figure 12 (right) is a film made three months after phrenic exeresis (three months later than Figure 11), showing elevation of the right hemidiaphragm and decrease in size of the cavity beneath the mid-portion of the 7th posterior rib.

right apical region. There was also a small rounded infiltrate in the mesial portion of the left apex. Small fibrocalcifications were present in the outer aspect of the second right interspace. The patient was hospitalized and her course was uneventful. All laboratory data were negative.

Previous x-ray studies were requested and films made on assignment to extended active duty revealed bilateral apical lesions (Fig. 3). These were fine, discrete, and fibrous in character. Comparison with our own films (Fig. 4) demonstrated definite activity and progression. Subsequent serial films and lordotic views (Fig. 5) during hospitalization of four months indicated that the lesion was quiescent.

CASE III: E. M., aged 23, 2d Lieutenant, A.N.C., had been examined roentgenographically twice a year since 1929, when it was discovered that her father had pulmonary tuberculosis. In 1938 she had pleurisy and was studied in a civilian sanatorium, and all tests were negative for tuberculosis. Subsequent roentgen studies were likewise negative. On interval examination, when she reported for duty at this hospital, films of the chest revealed several small calcified foci at the extreme left apex and many fibrotic infiltrations in the left first anterior interspace (Fig. 6). Subsequent serial roentgenograms showed the appearance of soft and fibrotic infiltrations in the left first anterior interspace, indicative of activity (Fig. 7).

CASE IV: W. M., aged 24, Staff Sergeant, had an x-ray examination for admission to Officers' Candidate School. This was considered unimpressive,



Fig. 13. Case V. Chest film made in September 1942. There is no evidence of cavitation. Tuberculous infiltrations have decreased markedly, but are present in the right lower lung field. There is also evidence of peribronchial fibrosis.

but because of increased markings in the left apex, a second roentgenogram was taken at the completion of his course. A lesion was demonstrated in the left upper lobe and the soldier was temporarily disqualified as an officer, but was returned to duty. Five

months later he was hospitalized for determination of activity. He was asymptomatic and physical examination was essentially negative. All laboratory data were negative. Chest films showed a minimal apical infiltration which was fibrotic in character (Fig. 8). This was better demonstrated in the lordotic view (Fig. 9). Serial examinations were made in a period of six months, during which time no apparent change had occurred. Lordotic views (Fig. 10) were again taken and demonstrated a definite increase in size of the lesions. This progression was merely suggested by an anteroposterior view. While this soldier had been asymptomatic, afebrile, and gained 15 lb. during hospitalization, x-ray studies had shown his lesion to be definitely active.

CASE V: B. B., aged 30, Corporal, felt well until April 1938, when, following an injury, he underwent an umbilectomy. Two months after operation he felt weak and listless and had lost 50 lb. in weight. A dry, hacking cough developed and profuse hemoptysis occurred. In August he was admitted to the Marine Hospital, where he was found to have a positive sputum. In view of the x-ray findings, a phrenic exeresis was done. The symptoms then subsided, the sputum remained negative, there was a gain of 40 lb., and the patient was discharged from the hospital, at his own request, within six months. He remained in good health and enlisted in the Army Air Corps on Sept. 12, 1940. No roentgenogram of the chest was made. He was assigned to clerical work and performed his duties without difficulty for two years. In August 1942, he was transferred to the Amphibian Command. With this change of work, he noticed fatigue and experienced a recurrence of cough and hemoptysis, for which he was hospitalized on Aug. 14, 1942. Physical examination revealed slight contraction of the right hemithorax and marked limitation, with flatness, absence of fremitus, and diminished breath sounds over the right lower lobe. The diaphragm was elevated and did not descend with inspiration. A chest film showed fibrotic infiltration of moderate extent in the mesial portion of the right apex. The right hilum was prominent and the lung markings in the right base showed evidence of peribronchial thickening. The right hemidiaphragm was 3 in. higher than the left and fluoroscopy showed a slight lag. Serial re-examinations showed no change. All other laboratory data were negative.

In view of the patient's medical history, films were requested from the Marine Hospital. These showed that in 1938 this soldier had had a large cavity, 4 cm. in diameter, in the right lower lobe (Fig. 11). This regressed rapidly after phrenic exeresis, but the lesion was still present (Fig. 12) and was evident on our own films (Fig. 13).

CASE VI: V. G., 2d Lieutenant, A.N.C., entered the Army on extended active duty Dec. 1, 1942. Three days later she had a final physical examination performed at this hospital. X-ray examination revealed a small, fibrous, discrete appearing lesion at

the extreme left apex (Fig. 14), and she was hospitalized for determination of activity. Physical examination was essentially negative. Serial films were taken at intervals of one week and within a period of fourteen days the infiltration had completely disappeared (Fig. 15). In this case, initial x-ray studies demonstrated what was considered a typical tuberculous infiltration but subsequently was proved to be a non-tuberculous lesion.

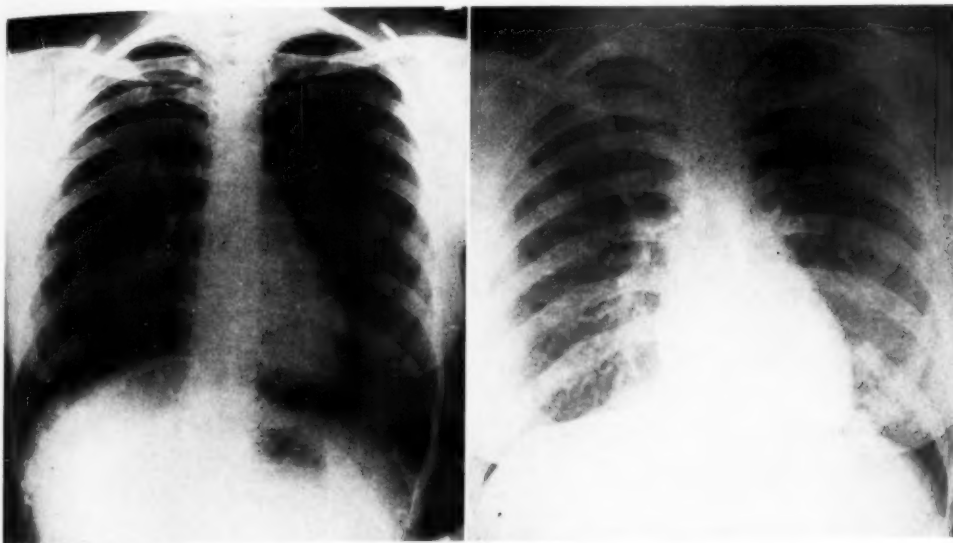
CASE VII: J. M., aged 49, Lieutenant Colonel, felt well until October 1942, when, while on maneuvers in Tennessee, he experienced a chill and a slight cough and was hospitalized for a primary atypical pneumonia. Within fifteen days he was discharged to duty. He then went to General Staff School in Leavenworth and felt well until Dec. 26, 1942, when he experienced generalized polyarthralgia, chills, and fever of 102°. He did not improve and was admitted to the Station Hospital for further treatment.

Inspection was essentially negative except for a healed thoracotomy scar on the left axillary line, the result of a suppurative pleurisy in childhood. Examination of the lungs revealed dullness over the left upper lobe; fremitus was decreased in this area. The breath sounds were bronchovesicular and distant in character. Fine, infrequent crackling rales were audible along the medial border of the left scapula.

Chest films (Fig. 17) revealed a diffuse fibrotic area of infiltration in the region of the left apex, extending down to the 6th rib posteriorly. Within this area were many small translucencies suggestive of cavities. There was a fibrotic infiltration in the right infraclavicular area. The picture was consistent with a chronic fibrocaseous pulmonary tuberculosis. Subsequent serial films (Fig. 18), however, over a period of five months, revealed a slow but progressive resolution of the infiltrations previously reported. In view of these findings, the diagnosis of chronic fibrocaseous tuberculosis was less tenable. Subsequent examinations (Fig. 19) showed further resolution until complete clearance had occurred. This case of primary atypical pneumonia illustrates the difficulty encountered in differential diagnosis, for the chest lesions cleared only after an observation period of nine months.

#### COMMENT

The plea for routine periodic x-ray examination of the lungs had its counterpart years ago when those interested in public health made a concerted effort to popularize periodic health examinations. The results of many surveys of isolated groups gave abundant evidence that an appreciable percentage of supposedly well people had unsuspected illnesses which were either preventable or could have been detected



Figs. 14 and 15. Case VI (asymptomatic). Figure 14 (left) is a routine chest film taken Dec. 10, 1942. A discrete fibrotic appearing lesion is present in the extreme left apex. This was considered to be tuberculous.

Figure 15 (right) is a film taken two weeks later, showing complete resolution of the lesion. This was confirmed by subsequent postero-anterior and lordotic views of the chest.

at their inception by careful and intelligent physical examination. That regular physical examinations, frequently repeated, could prevent suffering, promote longevity, and check the advance of progressive illnesses was generally appreciated by the medical profession. Insurance companies have stressed the importance of annual urinalyses for their policy holders. The impressive saving of lives among infants and children had its beginning and owes its success to this important phase of health education. No longer is expense an insuperable factor in procuring such services, since they are available in every walk of life.

The difficulty of detecting early manifestations of pulmonary tuberculosis, more especially in the young, discouraged pioneers in this work, for only a small number of active early lesions were disclosed in various surveys. It was only after the importance of x-ray examination of the chest came to be recognized as the most reliable method of detecting the disease in its incipency that significant progress was noted.

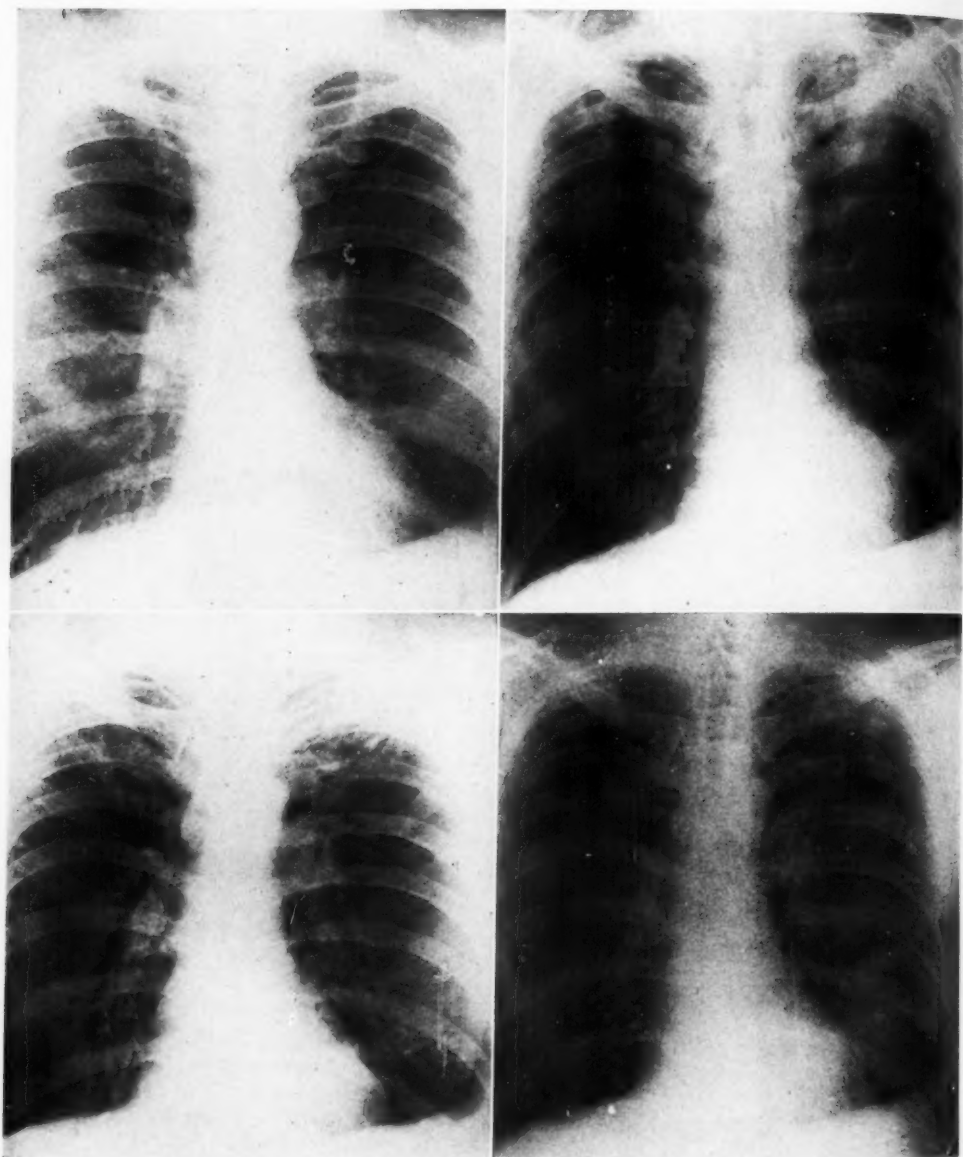
Minimal infiltrations of pulmonary tu-

berculosis may be suspected by a highly skilled examiner. It is doubtful, however, if this amounts to a definite conviction *without the aid of the x-ray*, except in a negligible number of instances. It is important that this phase of the subject be thoroughly appreciated. Nothing is more vital in dealing with this disease which still claims, unnecessarily, a large number of lives.

The final proof that x-ray examination is the only sure method of diagnosing early tuberculosis came with the routine examination of selectees for the Army. Films are also made prior to discharge from the Armed Forces for any cause. Thousands of medical officers appreciate this important advance in medical care. Induction films or those taken at other hospitals are gathered together for study whenever a suspicious pulmonary lesion is noted. Progression, regression, or the static nature of the lesion is appraised, new deposits are detected, and patients are retained for a sufficiently long period to establish a diagnosis.

"Mass roentgenography of itself cannot





Figs. 16-19. Case VII. Figure 16 (upper left) is the film taken for extended active duty, showing obliteration of the left costophrenic angle and adhesions to the left hemidiaphragm, the residuals of an old suppurative pleurisy. Chest otherwise negative.

Figure 17 (upper right) is the film made Jan. 2, 1943, five days after hospitalization. There are diffuse fibrotic appearing infiltrations in the region of the left apex, extending down to the 6th posterior rib. Many translucencies in this area are suggestive of cavitation. Fibrotic infiltrations are seen in the right infraclavicular area.

Figure 18 (lower left) is the film made in March 1943, showing resolution of the pneumonic process. Fibrotic appearing lesions are still present in the left apex, extending down to 4th posterior rib. Right lung infiltrations show little change.

Figure 19 (lower right), April 1943, shows the lesions previously noted to have almost completely disappeared. The picture is similar to that in Figure 16. Progressive resolution demonstrable in the serial films favored a diagnosis of atypical pneumonia.

be relied on for the diagnosis of tuberculosis and a negative finding is no guarantee that at some time the disease will not become apparent. It will, however, pick out subjects for further intensive investigation" (21). Almost all Army personnel have now had roentgen chest examinations. This personnel cannot, however, be considered to be free of pulmonary conditions indefinitely. Subsequent studies should be made. Only in this manner can small minimal, asymptomatic, tuberculous lesions be demonstrated and the patient be given the proper medical attention.

The present report, covering a relatively small number of patients is indicative of the soundness of this procedure. Not only in those having illnesses referable to the lungs, but in various services in the hospital, these early lesions have come to light. That error in technical procedure or enthusiasm in interpretation may not be subject to criticism is borne out significantly by the subsequent laboratory evidence. In the majority of instances, an account of minor weight loss, easy fatigue, and vagaries of appetite has been elicited in careful history taking. The great importance both to the individual and his comrades of detecting this insidious contagious disease in its very beginning cannot be overemphasized. Starting the sick patient on the latest approved treatment facilitates his recovery as well as reducing the number of days of suffering.

Mass chest roentgenography is the most impressive advance in the control of tuberculosis since the discovery of the offending organism.

#### SUMMARY

1. Roentgen examinations of the chest offer the best present method for detecting small minimal tuberculous lesions.
2. Induction films furnish a permanent and authoritative record which is useful in subsequent medical study.
3. Military service may activate latent or active foci, through fatigue, worry, lowered resistance, and irregular hours incident to training or combat.

4. Twenty-three patients, or 21.3 per cent of those admitted directly to the tuberculosis section of the Lovell General Hospital, were hospitalized solely because of the findings on routine roentgen examination of the chest. Eleven of these cases were subsequently proved active. In 6 of the 11 activity was proved only by regressive or progressive changes on serial x-ray examinations of the chest.

5. For 21 patients induction films were available from the Veterans Bureau or civilian hospitals. In 20 instances, tuberculous lesions were found to have been present at the time of entry into the Army. The 21st patient developed pulmonary tuberculosis nine months after induction. In 11 of the 20 cases the tuberculous lesions were overlooked at the time of induction. Four patients were considered "acceptable under MR 1-9" and of these 2 proved to have active lesions. In 5 patients the evidence was obtained from previous sanatorium films.

6. Lordotic views are helpful, giving increased visibility of cavities and other processes in the apices of the lungs. The procedure is simple, entails no additional expense, and should be resorted to more frequently in the examination of apical lesions.

7. Atypical pneumonias account for the majority of mistaken admissions for tuberculosis, and their differential diagnosis is difficult.

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## Roentgenologic Aspects of Retroperitoneal Perforations of the Duodenum<sup>1</sup>

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MOST PERFORATIONS of the duodenum occur into the free abdominal cavity and produce widespread contamination of the peritoneum. The signs and symptoms are well known and the diagnosis is promptly established. Early treatment has resulted in a surprisingly low mortality. In retroperitoneal perforations the reverse is true. The same area is involved and the same duodenal contents escape through the rent in the wall. Nevertheless, the mortality remains at 90 per cent. While the technical difficulties of repair and drainage are admittedly a factor, this high mortality is largely due to errors in diagnosis and procrastination in treatment. Any improvement in the accuracy and promptness of diagnosis should surely reflect a reduction in the mortality.

### ETIOLOGY

Although many retroperitoneal perforations of the duodenum occur as complications of peptic ulcer, the majority are due to trauma. In spite of its well protected anatomical location, about 10 per cent of all traumatic ruptures of the gastro-intestinal tract occur in this part of the bowel, one-third of them in its retroperitoneal portion. Occasionally they are multiple and perforate intraperitoneally and retroperitoneally at the same time.

Most of these injuries involving the duodenum are of the blunt type; they are believed to occur in one of three ways, namely, crushing of the bowel between the blunt force and the spine, bursting of a distended loop the ends of which are momentarily closed, and tearing at a region of fixed ligamentous attachment. Most of the cases reported have been due to such injuries as kicks or blows in the ab-

domen, crushing between heavy objects, or being run over by a vehicle. Compound injuries, in which there is a communication with the outside, will not be considered.

### CLINICAL FEATURES

The clinical features are especially important. Unless the attending physician bears in mind the possibility of a retroperitoneal perforation, the hope of an early diagnosis is lost. This is especially true in traumatic cases. It is a striking observation that comparatively few patients are greatly inconvenienced by the original trauma. Only a few vomit immediately, and the pain is in no sense severe. Many are able to walk following the injury. Few are unconscious. It is only upon the advent of the effects of the extravasation that the symptoms become marked. This is the reverse of intraperitoneal perforations. Rigidity is not a prominent symptom and when it develops, usually after several hours, it means that communication with the free abdominal cavity has occurred and peritonitis is developing. Laparotomy at this stage will reveal the hopelessness of the situation. The extravasated material, consisting of blood, bile, pancreatic juice, and other duodenal contents, is doubtless infected by this time and will have produced retroperitoneal cellulitis and necrosis. Peritonitis produced by such material cannot be expected to respond to treatment. It is important, therefore, that the early symptoms be ascribed to the underlying lesion and not to a contusion of the abdominal wall or a blow to the "solar plexus." It must be remembered that relatively minor injuries to the abdomen may rupture the bowel and that severe injuries may leave no visible marks of violence.

<sup>1</sup> Accepted for publication in March 1944.

## ROENTGENOLOGIC ASPECTS

The use of barium or bismuth salts in the roentgen diagnosis of any acute perforation of the gastro-intestinal tract is contraindicated. The diagnosis must depend on the demonstration of air that has escaped from the hollow viscus through the opening in the wall into the tissues or free into the abdominal cavity. The atmosphere as the source of this air must be excluded. Consequently, roentgenograms in cases of puncture wounds, bullet wounds, surgical accidents, etc., where the skin is broken, can have no value except in the demonstration of fractures or injuries to solid organs. In retroperitoneal perforations, the diagnosis depends on clinical or roentgenographic evidence of emphysema. This may become rather extensive in a short time depending on the rate of passage of air through the rent in the wall. Considerable crepitus has been encountered in patients surgically explored within an hour from the time of the injury. It may extend as far as the subcutaneous tissues of the neck and has been elicited on rectal examination. As a rule, considerable time is required before it can be observed clinically. The emphysema, of course, is significant only in that extravasation of other contents of the duodenum is implied.

It has been stated that over 90 per cent of the traumatic retroperitoneal perforations of the duodenum occur in the second and third portions. In most instances, therefore, the distribution of emphysema should be consistent. According to Miller (1), the findings at operation are distinct and practically pathognomonic. The extravasated blood and duodenal contents are nearly always found either in the root of the transverse mesocolon, in the root of the mesentery of the small bowel, or both, and in the intervening retroperitoneal space, very often extending somewhat to the right over the kidney. The tumor is usually crepitant, since it contains gas. Despite this almost pathognomonic appearance, in one-third of the cases studied

by Miller the lesion was not recognized at operation, although this was undertaken on a diagnosis of probable rupture of the bowel.

The course of the extravasated material may occasionally vary. Maddock (2) reported a case in which the suppurative process traveled laterally along the ribs, producing an abscess in the liver which pointed toward the lower axilla. In a case published by Keller (3) there were, as well as widespread retroperitoneal extravasation, purulent mediastinitis and pleurisy. Petren (4) recorded 4 cases of retroperitoneal perforation of ulcers of the second and third portions of the duodenum. He stated that the retroperitoneal inflammatory process may pass to the right kidney region and point anywhere between here and Poupart's ligament; it may extend to the left in a similar manner, or may spread along the large vessels up through the diaphragm to the mediastinum.

In the literature available to us, only three instances in which the diagnosis of retroperitoneal perforation of the duodenum was made by x-ray were found. Sperling and Rigler (5) reported the first case in 1937. Their patient was kicked in the abdomen by a horse. Roentgenograms made twenty-four hours later revealed the presence of gas about the right kidney, the right psoas muscle, and retrocecal region. There was no free air in the peritoneal cavity. Recovery followed conservative treatment without operation. Serial films showed a gradual diminution of the emphysema over a period of three weeks. Barium studies five months later revealed a deformity in the second portion of the duodenum in the region of the rupture.

The second case was reported by Ottenheimer and Gilman (6) in 1940. A student diver misjudged his distance and scraped his right anterior chest and abdomen on the springboard. In spite of severe pain and shock, he was able to get out of the pool with assistance. A leukocytosis of 22,000 cells (90 per cent polymorphonu-



clears) developed within two hours. Scout films of the abdomen showed considerable air in the retroperitoneal tissues surrounding the kidneys and along the psoas muscle. Operation within three hours from the time of injury revealed no evidence of serious intraperitoneal trauma or perforation. Crepitus was noted beneath the serosa of the lower part of the ascending colon, cecum, and terminal ileum, and in the mesentery of the terminal ileum. Lateral to the cecum and ascending colon there was extensive emphysema. The air was believed to have originated from the injury to the chest. The patient died thirty-eight hours later, and the source was proved to be a large retroperitoneal perforation of the duodenum at the junction of the second and third portions.

The third case is that of Somogyi (7), reported in 1941. His patient was suspected of having a perforated peptic ulcer and was examined roentgenographically for evidence of free air in the abdomen. None was detected, and the examination was repeated about five or six hours later. At this time a streak of air was observed surrounding the right kidney and extending downward retroperitoneally between the psoas muscle and the ascending colon.

In the course of the search for the origin of the emphysema, an oral contrast meal was administered and leakage was demonstrated from the posterior wall of the first portion of the duodenum into the retroperitoneal tissues. The patient ultimately died and the perforated ulcer was confirmed by autopsy.

Retroperitoneal perforations of the duodenum have been reported innumerable times. Most of the patients have shown emphysema at some time or other, usually in the location described by Miller. Eighteen out of 22 of his own cases showed crepitus. It is strange, indeed, that in spite of the frequency of the emphysema and the consistency of its location, the diagnosis by x-ray has been so rarely reported. It is significant that the roentgenographic appearance of the three cases cited above was so strikingly similar.

#### CASE REPORTS

The following two cases, we feel, are interesting and instructive. Unlike the vast majority of reported traumatic retroperitoneal perforations of the duodenum, each was the result of a blow in the back rather than in the abdomen. One patient was able to walk immediately after the injury; the other certainly would have been able to do so except for the cerebral concussion sustained at the same time.

**CASE I:** While unloading metal plate, a 50-year-old colored male was forced against a box car, injuring his right lower back. He complained only moderately of localized pain and tenderness. Although he could walk about without much distress, he was unable to continue working and was taken to his home. The pain gradually increased in intensity and later in the evening he vomited some fluid material but no blood. No improvement occurred during the night, and the next morning the man was admitted to the hospital by wheelchair. At this time his temperature was 102°, pulse 112 and of poor quality, respiration 32, and blood pressure 75/58. His blood count revealed 12,650 leukocytes, with a definite shift to the left. Examination of the urine showed albumin 1 plus and 25 to 50 red blood cells.

The patient was lethargic in mental response but was restless in bed. A firm, moderately tender mass five inches long and one inch wide was palpated in the right costal arch posteriorly. The abdomen was distended and the right flank was moderately swollen and tender. There was slight rigidity of the right abdominal wall. Treatment consisted in continuous duodenal drainage, sulfadiazine, and parenteral fluids. Uremia gradually developed and death occurred on the sixth day in the hospital.

Scout films of the abdomen taken the day after admission revealed linear fractures of both twelfth ribs about two inches from the spine. There was no evidence of free air or emphysema.

The clinical diagnosis was possible subcapsular or perirenal hemorrhage and possible perforation of the ascending colon.

Autopsy revealed an acute perforation of the anterior wall of the third portion of the duodenum leading directly into the root of the mesentery, with the formation of a huge, fetid, dissecting retroperitoneal phlegmon extending across the mid-line of the abdomen and surrounding the right kidney in the perinephritic fat tissue. It also dissected inferiorly from this region into the iliopsoas muscles, which were the seat of a fetid myositis, extending downward to the brim of the bony pelvis. The posterior parietal peritoneum on the right side was markedly displaced anteriorly. There was no evidence of a generalized peritonitis. The patient

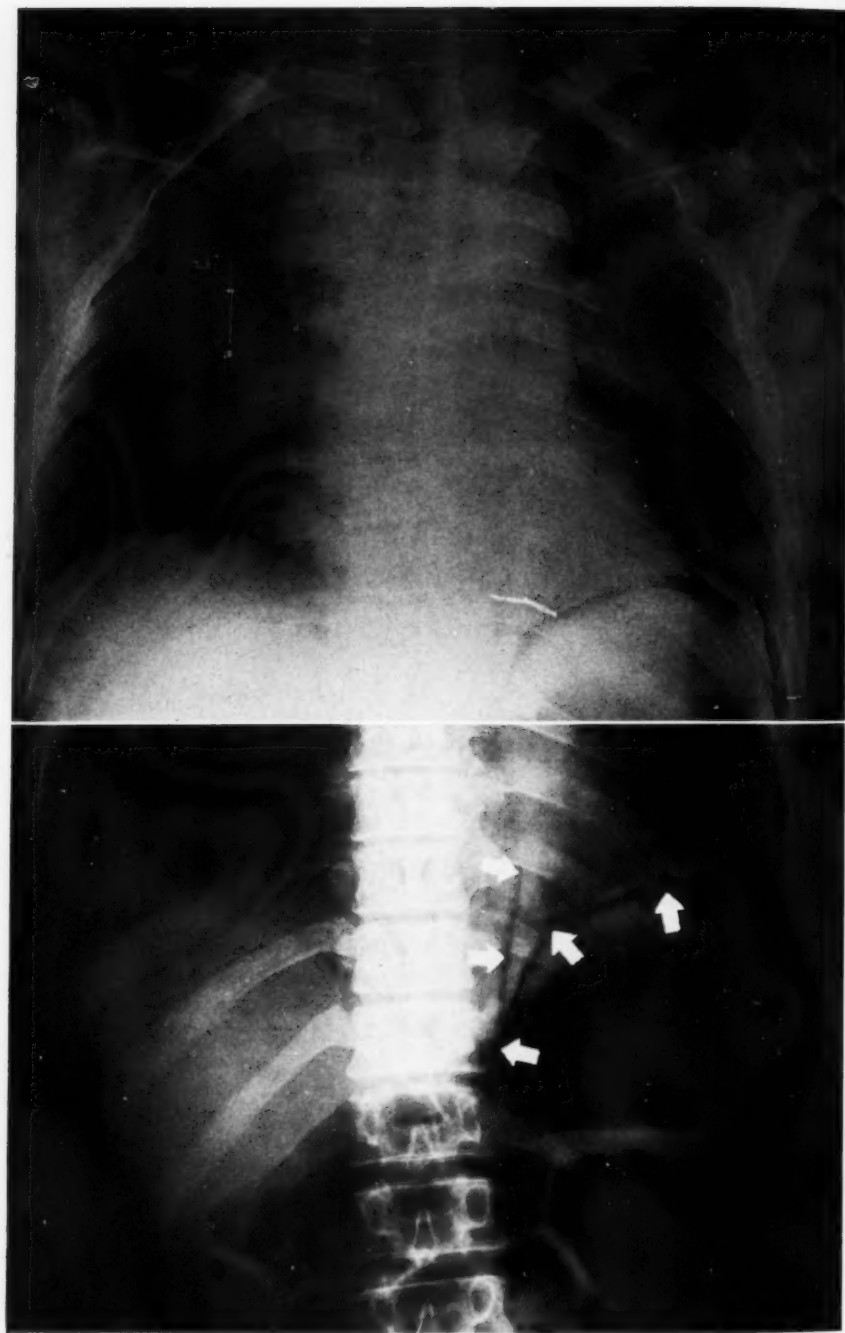


Fig. 1. Case II. Supine films of the chest and upper abdomen showing the fracture of the eleventh rib on the left and the streak of air (arrows) extending along the left side of the spine through the diaphragm to the inferior mediastinum and along the left leaf of the diaphragm.



Fig. 2. Case II. Right decubitus position. The location of the air streak remains the same.

also had a typical chronic peptic ulcer measuring 1.0 cm. in diameter, located in the superior wall of the cap and extending about 3.0 mm. in depth into the wall of the duodenum. There was no evidence of interstitial emphysema.

*Comment:* The absence of crepitus explains why the scout film examination in this case was of no value. It has been estimated that emphysema should be present in over 80 per cent of these cases. Had it been present, the films would have demonstrated it to be in the location described by Miller and demonstrated radiographically by Sperling and Rigler, Ottenheimer and Gilman, and Somogyi.

**CASE II:** A 46-year-old Italian laborer was struck in the left side of the back at about the level of the diaphragm by an overhead crane and was crushed against a wall. He fell to the floor and struck his head, causing a laceration of the scalp, contusion of the right eye, and a cerebral concussion. He was given first aid and brought to the hospital. X-ray examination revealed a linear fracture of the eleventh rib on the left side, 2 inches from the spine. A streak of air was noted extending along the left side of the spine (Figs. 1 and 2) through the diaphragm, presumably along the great vessels, to the

inferior mediastinum. Another streak of air branched off from this and extended along the left leaf of the diaphragm, apparently between the muscle and the parietal peritoneum. This appearance did not change with shift of position of the patient. There was no roentgen evidence of injury to the lungs or pleura. Our impression was that the air must have originated from a retroperitoneal perforation of a viscus, probably the third or fourth portion of the duodenum.

Clinically this patient was not very ill at any time. His chief complaint was abdominal distention and pain in the region of his fractured rib, which was referred (probably due to diaphragmatic irritation) to his left shoulder and arm. He ran a temperature of  $101^{\circ}$  for four days; the white blood count rose from 8,700 to 11,650 and fell to 6,750 on the fourteenth day in the hospital. A chest film taken on the seventh day showed no evidence of emphysema. Treatment was conservative, and the patient was discharged as improved on the fifteenth day.

*Comment:* This patient recovered without surgery, and the diagnosis, therefore, could not be proved beyond doubt. Nevertheless, we believe that a retroperitoneal perforation of the duodenum occurred and that the case represents one of the possible

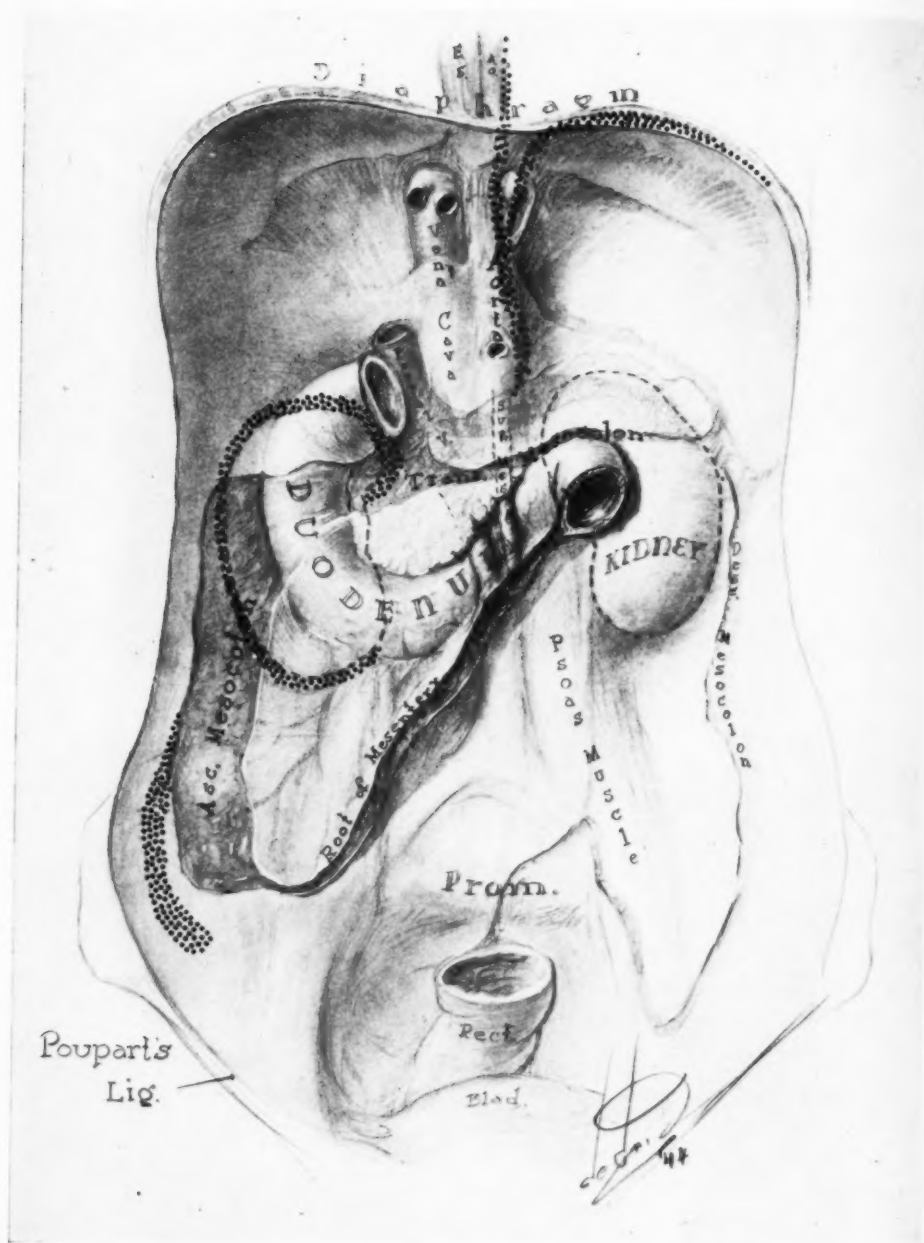


Fig. 3. Material extravasated through a retroperitoneal perforation of the duodenum will tend to extend along one or several of the following courses, depending on the location and duration of the perforation: (1) along the root of the transverse mesocolon; (2) along the root of the mesentery of the small bowel; (3) along both and in the intervening space; (4) over the right (rarely the left) kidney; (5) downward along the root of the mesentery of the ascending colon and cecum (clinically this may simulate and occasionally has been diagnosed as appendicitis or appendiceal abscess); (6) downward along the psoas muscle to the brim of the bony pelvis or to Poupart's ligament, simulating a psoas abscess; (7) along the great vessels through the diaphragm into the inferior mediastinum.

courses of the extravasated material (in this case chiefly air). Petren (4) and others have mentioned this path along the great vessels through the diaphragm to the mediastinum. Neither does the fact that the patient recovered without operation alter our opinion. Most surgeons have observed recovery in cases of perforation of a hollow viscus where surgery has been refused. Ravdin (8) expressed the opinion that the time of operation is not so important as what is happening to the patient. The content of the viscus at the time of perforation is most important. Barber and Madden (9) used elective conservative therapy in 5 cases of proved intraperitoneal perforation with no deaths.

#### DISCUSSION

The roentgenographic diagnosis of retroperitoneal perforation of the duodenum should not be difficult in most instances. Good films are important and proper positioning is imperative. Films of the abdomen should be made with the patient in the supine, the upright, the left lateral decubitus, and the lateral positions. From the standpoint of safety and accurate roentgen diagnosis, the patient suspected of having a perforated viscus should be advised to lie on his left side so that air rather than contents would escape through the perforation. In the event that the examination is negative, it may be repeated after a few hours unless immediate surgical intervention is indicated. Stereoscopic films may assist in localization of the emphysema. Examination of the patient in various positions must be carried out to determine whether the air is fixed in the tissues or free in the abdominal cavity or both.

While, as stated above, most retroperitoneal perforations of the duodenum are the result of trauma, peptic ulcers may gradually perforate posteriorly into preformed adhesions, the pancreas, colon, or some other viscus. These may heal spontaneously and disappear or may result in abscess or fistula formation. They are usually discovered during barium studies



Fig. 4. Perirenal helium injection. The retroperitoneal distribution of the gas is similar to that of duodenal origin. The tendency of the gas to extend along the vessels, through the diaphragm to the inferior mediastinum, can be noted.

of the gastro-intestinal tract and are not within the scope of this communication. However, those acute, retroperitoneally perforating ulcers of the duodenum, especially of the second or third portions, must be included in the discussion of perforations due to trauma. The clinical and roentgen findings are essentially the same. Only the history of trauma is absent.

The scarcity of reported cases of retroperitoneal perforation in which the roentgen appearance has been described necessitates the use of operative and postmortem material in formulating what may be described as rather typical roentgenologic findings. It would seem from the roentgenographic point of view that the emphysema would tend to follow one or several courses. Figure 3 is intended as an anatomical review of the relations of the duodenum to the retroperitoneal structures and to depict the paths of the extravasated material.

If the point of extravasation is not closed by nature or repaired surgically, the material will accumulate in the retroperitoneal tissues. The result will be a combination



of several of the above courses, as described in the pathological report in Case I. The lateral film may be most important in the demonstration of emphysema in early cases where it is confined to the roots of the mesentery.

Figure 4 is a film of a perirenal helium injection and is presented only because of its similarity to retroperitoneal emphysema of duodenal origin surrounding the kidneys. The tendency of the gas to spread along the vessels through the diaphragm to the inferior mediastinum can be noted.

*Differential Diagnosis:* Free air in the abdomen, whether due to perforation of a hollow viscus, recent surgical operation, a tubal patency test, or any other cause, may give rise to emphysema of the extraperitoneal tissues. The exact mode of entry of the air is not always clear. A parietal peritoneum broken by trauma or surgery or damaged by infection may allow permeation of the pneumoperitoneum even to the subcutaneous tissues, where it can be palpated clinically. McCorkle and Stevenson (10) in 1937 reported an excellent example of this. In a patient with an intraperitoneal perforation of an anterior wall duodenal ulcer there developed a marked pneumoperitoneum and an extensive emphysema extending up the chest wall to the axillae, shoulders, upper arms, and neck.

Another mechanism of subcutaneous emphysema was described by Vigyázó (11), who in 1926 reported a case in which a callous ulcer on the anterior wall of the duodenum perforated and emphysema was noted around the umbilicus. He felt that the most likely path of the extravasated air was subserously along the duodenohepatic and round ligaments to the umbilical area.

These are examples of subcutaneous emphysema and, while they are confusing, they are rare and can usually be differentiated from the retroperitoneal air seen in duodenal perforations. Scout films of the abdomen would show the emphysema to be subcutaneous and confined more to the anterior and lateral walls.

Other cases have been reported in which gastric ulcers located near the cardia have perforated directly into the mediastinum, giving rise to emphysema in that region.

Perforations of the portions of the colon not covered by peritoneum, whether due to benign or malignant ulcerations or trauma, may give rise to retroperitoneal emphysema. Unless the perforation occurs in the right half, however, it should not be confused with a retroperitoneal perforation of the duodenum. In the presence of the emphysema, barium enemata are contraindicated.

Perforations of the duodenum into neighboring solid organs or the biliary tract would not be expected to present a confusing picture.

Another important condition which must be differentiated from extraperitoneal extravasation of gas is the localized pneumoperitoneum sometimes observed in instances of perforation of the small bowel distal to the duodenum. Most authorities agree that a small amount of air is extravasated in practically all perforations of the small intestine. When this occurs in the upper jejunum, the air tends to rise behind the omentum up to the transverse mesocolon, where it becomes loculated. Radiographically it usually appears as an irregular area of decreased density to the left of the second lumbar vertebra. Massie (12) described a case in 1924 in which a diagnosis was made on this appearance. At operation the duodenojejunal junction was found to be completely severed. Recovery followed repair of the injury. This diagnostic sign becomes especially important when it is realized that the majority of ruptures of the small bowel occur in the upper jejunum. The radiologist must be familiar with these irregular areas of localized pneumoperitoneum, interpret them accordingly, and not confuse them with air within a viscus or in the retroperitoneal tissues.

#### SUMMARY AND CONCLUSION

1. The great majority of retroperitoneal perforations of the duodenum are due

to trauma and usually occur in the second or third portion.

2. The mortality is extremely high, approximately 90 per cent. Death is due to retroperitoneal cellulitis, which in most instances eventually communicates with the free peritoneal cavity.

3. Early clinical diagnosis is rare and the institution of treatment usually delayed.

4. Retroperitoneal perforations of the duodenum have been reported in the literature scores of times. Emphysema was noted, either clinically or at operation or autopsy, in approximately 80 per cent. In spite of this, the diagnosis by x-ray has been reported only three times.

5. Proper x-ray examination should, in most instances, render this difficult diagnosis a relatively easy one, possibly within an hour or two of the injury.

6. Paths of extension of the extravasated material are depicted.

7. Two cases with practically identical injuries are presented. The first was proved by postmortem examination but x-ray findings were negative. The second patient recovered without surgery and, while the diagnosis was not proved beyond doubt, highly suggestive radiographic evidence was present. It seems justifiable to record this case and to direct attention to

this sometimes neglected type of perforation.

NOTE: We wish to thank Dr. Leon J. Leahy of the Department of Surgery for permission to report these two cases from his surgical service.

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# Dosage Table for Linear Radium Sources<sup>1</sup>

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THE EXPRESSION of tissue dosage in terms of roentgens is becoming general in x-ray and radium therapy. For interstitial radium or radon sources, the literature contains data for several satisfactory methods of determining the minimum dose delivered within a volume implanted with needles or seeds in accordance with certain general principles. In the case of single linear sources, however, such as are commonly employed in the treatment of cervical and rectal cancer, information is not so accessible. The most generally used charts, those of Patterson and Parker (1), give the number of milligram-hours necessary to deliver 1,000 r<sub>y</sub> at points in a plane perpendicular to the source at its mid-point, up to 3 cm. distance. For positions not in this central plane, or for greater distances, they are not helpful. Sievert (2) and Laurence (3) have presented extensive data, but in rather complicated mathematical forms. Mayneord and Honeyburne (4) have published a general method for drawing isodose curves around any particular linear source; this is also too involved for ready use in the radiological department. Wolf (5, 6) gives data for the dosage in roentgens per milligram-hour in a plane perpendicular to the implant at its end, for a wide range of lengths of source and distances from the radium. The advantage of having the data for the end rather than for the middle of the needle is that any implant can be considered a combination of two segments, and the doses along lines perpendicular to the source at any desired point can be obtained by choosing the segments so that their ends come at that point. For instance, doses along a line perpendicular to a 4-cm. needle at a point 1 cm. from either end would be obtained as the

sum of doses from a 3-cm. and a 1-cm. needle, the former containing three times as much radium as the latter.

For ready use in the radiological department, there appears to be a need for a more straightforward table, from which, within practical limits, doses for a given treatment can be read directly, not only along perpendiculars to the source at central or end-points, but anywhere in the vicinity. Such a table is presented herewith.

Some years ago the author published charts and tables giving relative doses at different distances on perpendiculars erected at different positions along the linear sources (7). This was prior to the general acceptance of the gamma roentgen as a dosage unit, but in order to obtain the values in roentgens it is necessary only to establish the dosage for some one particular source and position. This has been done by taking the dose from a point source at 1 cm. distance, filtered by 0.5 mm. Pt, as 8.4 r<sub>y</sub>. The material is presented in Table I.

Doses are given in gamma roentgens per 100 mg.-hr., at various distances along perpendiculars to the sources, at 0.5-cm. intervals along their lengths, as indicated in Figure 1. Line A is always perpendicular at the mid-point, line B, 0.5 cm. out toward the end; line C, 1.0 cm. out, etc. Thus line B is at the end of a tube 1.0 cm. long, line D at the end of a tube 3.0 cm. long, etc. The data are carried out for lines beyond the ends of the sources, so that doses for two or three in tandem can be summed, for any position along the group.

Distances are measured from the central axis of the tube. The range of tube lengths is from 0.5 to 8.0 cm., by 0.5-cm. steps to 3.0 cm., and then by 1.0-cm. steps to 6.0 cm. Distances, tube lengths, and positions

<sup>1</sup> Accepted for publication in August 1944.

Fig. 1. Diagram showing relative positions of lines along which values are tabulated. The lines are 0.5 cm. apart.

the axis of the source; no allowance is made for self-absorption in the salt, although it is realized that this may be considerable for positions very close to the ends of long needles. The filter is 0.5 mm. Pt. Allowance is made for the increase in filter when the rays emerge obliquely. If the filter is more than 0.5 mm. Pt, the doses will, of course, be less. The actual correction for increase in filter depends somewhat on the position of the point under consideration, that is, its distance from the source and whether or not it lies beyond the end of the source. By calculating the effect of additional filter for a series of representative points, however, it has been possible to establish satisfactory correction factors, applicable to most of the

TABLE I: GAMMA ROENTGENS PER 100 MG.-HR., DELIVERED AT VARIOUS DISTANCES FROM VARIOUS POINTS ALONG LINEAR RADIUM SOURCES (Filter 0.5 mm. Pt)

Cm. from Tube	Distance along Tube Axis: Cm. from Center										
	A Center	B 0.5	C 1.0	D 1.5	E 2.0	F 2.5	G 3.0	H 3.5	I 4.0	J 4.5	K 5.0
Tube 0.5 cm. long											
0.5	2,850	1,720	665	322	162	104	68	47	30	20	20
0.75	1,333	1,000	527	288	152	103	72	53	40	21	21
1.0	800	625	417	250	150	102	72	54	42	33	26
1.5	364	328	256	179	125	91	69	54	43	33	28
2.0	206	195	164	130	98	75	59	49	38	30	26
2.5	133	127	113	98	77	62	52	42	35	30	25
3.0	92	89	83	73	62	52	44	37	31	27	23
4.0	52	51	48	45	41	36	32	28	25	22	19
5.0	33	33	32	30	28	26	24	22	20	18	16
Tube 1.0 cm. long											
0.5	2,500	1,760	667	325	170	105	69	47	30	20	20
0.75	1,250	950	527	291	163	106	73	53	40	22	21
1.0	740	606	417	254	154	104	73	54	42	33	26
1.5	352	323	256	186	128	92	69	54	43	33	28
2.0	204	193	163	130	99	76	59	47	38	30	26
2.5	132	125	113	97	78	62	52	42	35	30	25
3.0	92	89	83	73	62	52	44	37	31	27	23
4.0	52	51	48	45	41	36	32	28	25	22	19
5.0	33	33	32	30	28	26	24	22	20	18	16
Tube 1.5 cm. long											
0.5	2,080	1,742	770	333	182	111	72	48	30	20	20
0.75	1,180	955	556	298	175	111	74	53	40	25	21
1.0	667	588	417	256	160	106	74	54	42	33	26
1.5	333	317	256	182	132	94	70	54	43	33	28
2.0	200	190	162	130	101	77	60	47	38	30	26
2.5	128	123	112	96	79	64	52	42	35	30	25
3.0	90	89	82	72	62	52	44	37	31	27	23
4.0	52	51	48	45	41	36	32	28	25	22	19
5.0	33	33	32	30	28	26	24	22	20	18	16
Tube 2.0 cm. long											
0.5	1,800	1,720	910	385	195	115	76	49	33	22	20
0.75	1,111	955	625	333	189	115	77	53	40	29	21
1.0	625	570	435	270	168	110	75	55	42	33	26
1.5	333	303	257	189	135	97	70	54	43	33	28
2.0	196	185	159	131	102	78	61	48	39	31	26
2.5	125	121	111	96	80	65	52	43	35	30	25
3.0	89	88	81	72	62	52	44	37	31	27	23
4.0	51	50	48	45	40	36	32	28	25	22	19
5.0	33	33	32	30	28	26	24	22	20	18	16
Tube 2.5 cm. long											
0.5	1,548	1,500	1,010	515	252	130	82	52	35	26	24
0.75	1,000	895	667	377	218	128	83	57	40	32	24
1.0	582	548	445	293	185	121	80	57	42	34	27
1.5	305	295	254	191	139	102	74	54	43	34	27
2.0	185	178	158	131	104	80	63	49	40	32	26
2.5	122	117	109	95	80	66	53	43	35	30	25
3.0	87	86	80	71	62	53	45	37	31	28	23
4.0	51	50	48	44	40	36	32	28	25	22	19
5.0	33	32	32	30	28	26	24	22	20	18	16

region about the implant. These factors are correct within plus or minus 5 per cent for all points within the region enclosed by perpendiculars from the ends of the source,

and for points outside that region except where they are 1.0 cm. or less from the axis of the needle, and farther beyond its end than half the length of the needle,



TABLE I: GAMMA ROENTGENS PER 100 MG.-HR., DELIVERED AT VARIOUS DISTANCES FROM VARIOUS POINTS ALONG LINEAR RADIUM SOURCES—Continued  
(Filter 0.5 mm. Pt)

Cm. from Tube	Distance along Tube Axis: Cm. from Center										
	A Center	B 0.5	C 1.0	D 1.5	E 2.0	F 2.5	G 3.0	H 3.5	I 4.0	J 4.5	K 5.0
Tube 3.0 cm. long											
0.5	1,430	1,333	1,111	645	310	145	88	59	41	31	26
0.75	910	835	690	435	250	141	89	61	43	34	26
1.0	540	526	454	323	202	133	86	61	44	34	28
1.5	286	286	250	193	143	107	77	54	43	34	27
2.0	179	173	156	132	106	83	65	51	40	32	26
2.5	119	115	107	95	81	67	53	44	36	30	25
3.0	85	84	78	71	62	54	45	38	32	28	22
4.0	50	49	48	44	40	36	32	28	25	22	20
5.0	32	32	31	30	28	26	24	22	20	18	16
Tube 4.0 cm. long											
0.5	1,111	1,050	1,000	910	500	222	118	72	48	33	26
0.75	690	667	625	453	344	192	114	73	50	36	26
1.0	435	435	418	333	256	164	107	71	50	36	28
1.5	256	238	228	193	159	120	89	62	48	35	27
2.0	161	158	148	132	111	89	70	55	44	32	26
2.5	111	107	104	92	82	71	58	48	38	31	25
3.0	82	80	76	70	62	56	47	40	33	28	22
4.0	48	48	46	44	40	36	32	29	25	22	20
5.0	32	31	30	29	28	26	24	22	20	18	16
Tube 5.0 cm. long											
0.5	833	827	820	800	715	400	200	100	62	41	26
0.75	572	555	525	465	377	273	155	95	62	42	26
1.0	370	370	364	333	286	213	136	88	61	42	28
1.5	228	217	213	194	167	135	100	73	56	38	31
2.0	148	143	137	128	112	94	76	64	48	36	29
2.5	103	100	97	91	82	73	60	50	41	33	27
3.0	77	75	72	68	62	56	48	41	35	29	25
4.0	46	46	44	42	40	36	33	29	25	22	21
5.0	31	30	30	29	27	25	24	22	20	18	18
Tube 6.0 cm. long											
0.5	740	735	730	715	690	605	345	167	86	51	33
0.75	500	495	490	450	418	371	244	139	84	52	35
1.0	333	333	321	310	294	250	179	115	77	52	37
1.5	200	200	196	194	175	152	118	91	67	42	35
2.0	134	132	128	123	112	99	82	66	52	41	31
2.5	96	93	91	89	83	74	62	53	43	35	30
3.0	75	72	69	66	63	57	50	42	36	31	25
4.0	44	44	42	41	39	36	33	30	26	22	18
5.0	30	30	29	28	27	25	24	22	20	18	18
Tube 8.0 cm. long											
0.5	556	550	543	532	522	511	500	434	250	114	62
0.75	357	352	345	333	323	313	303	256	179	102	62
1.0	267	266	264	252	244	236	222	170	136	89	60
1.5	162	159	154	148	143	137	132	108	91	69	53
2.0	116	115	109	105	102	96	89	78	66	54	41
2.5	83	81	78	75	73	72	67	57	50	44	36
3.0	64	61	60	58	52	51	50	43	37	30	25
4.0	40	40	39	38	37	34	33	30	26	22	18
5.0	28	28	27	27	26	24	24	22	21	19	18

(e.g., at 1.0 cm. or less on or beyond line D for a 2.0-cm. tube, G, for a 4.0-cm., J for a 6.0-cm.). Within these limits, for 1.0 mm. Pt filter the gamma roentgens per 100

mg.-hr. are 90 per cent less than those tabulated; for 2.0 mm. Pt, 80 per cent less.

Some examples will serve to illustrate the use of the table:

(1) A cervix tandem consists of two capsules; the upper one contains 25 mg. radium and is 2.0 cm. in active length; the lower one contains 50 mg. of radium and is 3.0 cm. in active length; each is filtered by 0.5 mm. Pt. Between the active portions of the capsules is a space of 1.0 cm., including the ends of the tubes and the knot separating the two capsules in the rubber tubing holding the tandem. What is the dose at a distance of 2.0 cm. out from each end and from the middle of this applicator, if it is left in place for forty hours (for a total of 3,000 mg.-hr.)? In this period, the upper tube gives 1,000 mg.-hr., and the lower 2,000. The lower end of the tandem is 1.5 cm. below the center of the stronger tube and 5.0 cm. below the center of the weaker (Fig. 2). From the table it is found that at a distance of 2.0 cm. out along line *D*, 1.5 cm. from the mid-point of the 3.0-cm. tube (Point *X*, Fig. 2),

serted in the parametrium so that they lie approximately in an anteroposterior plane with the lower ends 0.5 cm. apart and the upper 1.0 cm. apart (Fig. 3). They are to be left in place 100 hours; hence each one supplies 300 mg.-hr. What is the dose midway between two needles at the upper end of the active portion, and 1.0 cm. outside the outer needle at the center (points *P* and *Q*)? Point *P* is 0.5 cm. from needles I and II, and 1.5 cm. from III, along lines perpendicular to their ends, or 1.5 cm. from their centers (line *D*). From the table, for 3.0-cm. needles, 100 mg.-hr. give 645 and 193 r<sub>y</sub> at 0.5 and 1.5 cm., respectively, along this line. Hence the dose at *A* is  $(3 \times 645) \times 2 + (3 \times 193) = 4,440$  r<sub>y</sub>. At *Q*, the distance along perpendiculars at the centers of the needles, (line *A*) are 1.0, 1.75, and 2.5 cm., respectively. The value for 1.75 cm. must be found by interpolation between 1.5 and 2.0. The

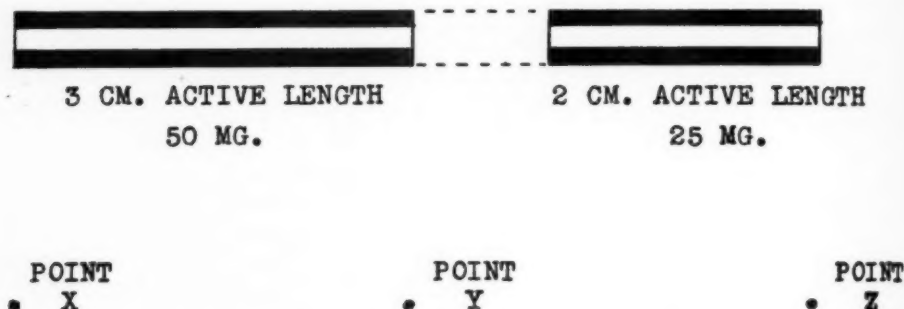


Fig. 2. Diagram of active portion of cervix tandem considered in Example 1.

100 mg.-hr. furnish a dose of 132 r<sub>y</sub>. Hence 2,000 mg.-hr. will give  $(2,000/100) \times 132 = 2,640$  r<sub>y</sub>. At a distance of 2.0 cm. out along line *K*, 5.0 cm. from the center of a 2.0-cm. tube, 100 mg.-hr. give 26 r<sub>y</sub>, so that 1,000 mg.-hr. will supply 260, giving a total dose at this point of  $2,640 + 260 = 2,900$  r<sub>y</sub>. Similarly, the dose opposite the center of the tandem, which is at the upper end of the strong tube (point *Y*), is the sum of those given by 2,000 mg.-hr. along line *D*, 1.5 cm. from the center of a 3.0 cm. tube, and 1,000 mg.-hr. along line *D*, 1.5 cm. from the center of a 2.0-cm. tube. At 2.0 cm. out from the radium along these lines, the doses are 132 r<sub>y</sub> and 131 r<sub>y</sub>, respectively, per mg.-hr.; accordingly the sum is  $(20 \times 132) + (10 \times 131) = 3,950$  r<sub>y</sub>. In the same manner, the dose 2.0 cm. out from the upper end is found to be  $(159 \times 10) + (32 \times 20) = 2,230$  r<sub>y</sub>. If the tandem had been considered a uniform source 6.0 cm. long, left in place for 3,000 mg.-hr., instead of the two different tubes specified, the doses at points *X*, *Y*, and *Z*, would have been 2,460, 4,020, and 2,460 r<sub>y</sub>, respectively. These are 18 per cent low for *X*, 2 per cent high for *Y* (negligible difference), and 11 per cent high for *Z*.

(2) Three needles, each having an active length of 3.0 cm., and a radium content of 3.0 mg., are in

dose is  $(3 \times 540) + (3 \times 232) + (3 \times 119) = 2,673$  r<sub>y</sub>.

(3) A rectal lesion is to be treated by means of a radium applicator 6.0 cm. long, 2.0 cm. in diameter, with a total filtration equivalent to 2.0 mm. Pt. The lesion is about 1.0 cm. thick in its deepest region; the applicator is to be placed so that this comes as nearly as possible at the mid-point. The lesion extends upward for possibly 2.0 cm. more, where it may be 0.5 cm. thick. It is desired to give 4,000 r<sub>y</sub> to the deepest portion, and to know what dose will then be delivered at the upper margin. Since the applicator is 2.0 cm. in diameter, or 1.0 cm. in radius, the deepest part of the lesion, 1.0 cm. deep, lies 2.0 cm. from the radium, along a line at the mid-point of the applicator (line *A*). At this point, a 6.0-cm. source filtered by 0.5 mm. Pt. delivers 134 r<sub>y</sub> per 100 mg.-hr. The allowance for the extra filter reduces this to 80 per cent of 134, or 107 r<sub>y</sub> per 100 mg.-hr. To deliver 4,000 r<sub>y</sub> requires  $(4,000/107) \times 100 = 3,750$  mg.-hr. The upper part of the lesion, 0.5 cm. thick, lies on a line 2.0 cm. from the mid-point (line *E*). Here 100 mg.-hr. gives 175 r<sub>y</sub> 1.5 cm. from the radium for 0.5 mm. Pt. or 140 for 2.0 mm. Pt. Hence, 3,700 mg.-hr. give 4,180 r<sub>y</sub>.

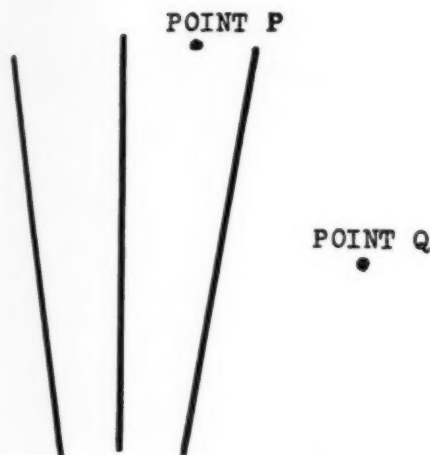


Fig. 3. Diagram of parametrial needles considered in Example 2. Each needle has an active length of 3.0 cm., and radium content of 3.0 mg.

By methods illustrated by these examples, it is a simple matter to determine the dose delivered at any point within a reasonable range of any linear source (tube or needle) or simple combination of such sources, kept in place for any specified time. Conversely, the time necessary to deliver a certain dose at a specified point with such a source can be found. In general, such calculations are desirable for treatments of the types discussed

above. When a volume of tissue is more uniformly treated by needles in one or several planes, or by seeds, the dose desired is usually the minimum dose to the lesion, and this can more readily be found from the data published elsewhere for volume dosage (9, 10).

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## Priodax: A Contrast Medium for Cholecystography<sup>1</sup>

Analysis of 163 Cases, Outlining the Various Reactions in Three Technics and the Operative Findings in 22 Cases

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IN LESS THAN TWO decades cholecystography has been developed and has become an almost routine procedure for the study of suspected gallbladder disease. The accuracy of the procedure in determining the presence of a diseased gallbladder is about 95 per cent. This high percentage of accuracy adds emphasis to the clinical significance of such a study as well as the need for further refinement in technic.

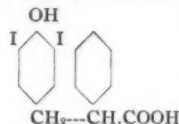
Since the original publication of Graham and Cole (3) describing a method of x-ray demonstration of the gallbladder by the intravenous injection of tetrabromphenolphthalein, roentgenologists, clinicians, physiologists, and chemists have worked to improve this method, using various chemicals and technics. Tetraiodophenolphthalein was discarded by Graham and Cole (4,5) in their original experiments because of its apparent toxicity. Further study proved these untoward reactions were due to impurities and could in great measure be eliminated by purification. In less than one year's time after the original publication, tetraiodophenolphthalein had replaced the tetrabromphenolphthalein, and it has been used almost exclusively up until the recent introduction of Priodax.

The first clinical reports on cholecystography with Priodax were from Germany, where it was known as Biliselectan, in 1940. Kleiber (8) reported 55 cases. Twenty-five of these did not show a gallbladder shadow. These cases were checked by the use of tetraiodophenolphthalein, with the same findings. Twenty-four of the positive cases were verified by surgical exploration, and gallstones were found in

all. The author concluded that Biliselectan was an excellent contrast medium for cholecystography and relatively free from side effects, such as nausea, diarrhea, and vomiting.

The conclusions of Kleiber were confirmed by other reports in the foreign literature (Lauer-Schmaltz, 9; Grunke and Finiger, 6; Rittweger, 15; Naumann, 13; Rating, 14) and later in the American literature (Einsel and Einsel, 2; Wasch, 17; Marshall, 10).

Priodax chemically is a beta-(4-hydroxy-3,5 diiodophenyl) - alpha - phenyl-propionic acid with the following structural formula:



It is a white, odorless powder, soluble in alkali, ether, alcohol, and acetone, but almost insoluble in water. The sodium salt, however, is very soluble in water. Priodax contains 51.5 per cent iodine.

Experimental studies by Modell (12), with cats as subjects, showed that the intravenous injection of Biliselectan produced medullary convulsions. The lethal dose was approximately 150 mg. per kilogram body weight when given intravenously. Oral administration proved much less toxic, the lethal dose being as high as 1,000 mg. per kilogram body weight. Other toxic symptoms noted were impaired appetite, nausea, vomiting, and general depression. The emetic effect was shown to be due to local irritation of the gastrointestinal tract, since it did not occur with intravenous injections. Postmortem examination, however, did not reveal any evidence of intestinal irritation. Albuminuria was a constant finding, and in one

<sup>1</sup> From the Department of Radiology, Watts Hospital, Durham, N. C. Accepted for publication in March 1944.

TABLE I: SIDE EFFECTS OF PRIODAX  
(163 Cases)

Method	None	Nausea	Diarrhea	Distress	Burning Sensation		
					Anus	Bladder	Throat
Double dose	14	21	39	9	13	11	4
Single dose	31	4	9	..	3	9	3
Divided dose	30	11	9	5	3	4	6

animal receiving 1,000 mg. per kilogram body weight there were venous congestion and parenchymatous degeneration of the kidney tubules.

Junkmann (7) found that during the first twenty-four hours after intake more than 50 per cent of Biliselectan was excreted through the kidneys. In contrast with this, when tetraiodophenolphthalein is used, less than 10 per cent is excreted through the kidneys. The remaining portion of tetraiodophenolphthalein is eliminated through the gastro-intestinal tract, which is a highly undesirable feature, since the gallbladder is often obscured by the presence of the medium in the region of the hepatic flexure of the colon.

Priodax is supplied in tablets, each containing 0.5 gm. of the radiopaque substance. The manufacturers recommend 3.0 gm. as the average adult dose. If the dose is to be adjusted to body weight, as is necessary in children, one tablet for each 25 pounds of body weight is considered adequate. The tablets may be swallowed whole with sips of liquid, such as water or fruit juice. The tablets should not be chewed, since they produce an unpleasant burning sensation in the mouth.

#### MATERIAL

Our observations are based on 163 unselected, consecutive cases. Three methods of oral administration of the dye were used in order to arrive at a satisfactory routine procedure. The case distribution for the various technics was as follows: (1) double dose, 57; (2) divided dose, 55; (3) single dose, 51. The youngest patient was seventeen years old and the oldest eighty-two. There was a rather even distribution between these two extremes, as well as a fairly even sex distribution.

#### TECHNIC

For the double dose administration the patient was given the following instructions. At noon on the day before the x-ray examination, eat a large meal and include two or three pieces of butter. One hour after completing the meal take the entire contents of one package of Priodax (6 tablets) with a glass of water. During the afternoon eat nothing and drink only water. At 6:00 P.M. eat a fat-free meal consisting of fruit juices, crackers, and sweetened tea or coffee without cream. One hour after supper take the second package of Priodax (6 tablets) with a glass of water. Eat nothing thereafter and drink only a moderate amount of water. Report to the x-ray department the following morning at 8:30.

The divided dose technic substituted 3 tablets following the noon and evening meal instead of 6 as outlined in the double dose. For the single dose all 6 tablets were given following the fat-free evening meal. The other instructions were not changed.

#### TOXIC EFFECTS

Table I shows the side effects in 163 cases. We want to emphasize that in tabulating these findings every symptom that could be attributed to the Priodax was recorded. One liquid or soft bowel movement was included in the diarrhea column. In many instances symptoms reported as distress or nausea were revealed only after specific questioning. If we considered only pronounced symptoms, the statistics would be quite different, as follows: for the double dose group, nausea in 1 and diarrhea in 10; for the single dose, nausea in 1 and diarrhea in none; for the divided dose group, nausea in none and diarrhea in 1.



TABLE II: GALLBLADDER VISUALIZATION WITH PRIODAX: COMPARISON OF TECHNICS (163 Cases)

Method	Cases	Good	Concentration Poor	None	Number of Cases Showing Calculi
Double dose	57	77.4%	12%	10.4%	5
Single dose	51	74.5%	11.8%	13.7%	6
Divided dose	55	83.6%	9.4%	7%	2

The burning sensation was of no great significance. In the throat the patient had a sensation of a slightly caustic substance being swallowed that was of only momentary duration. The bladder symptoms were noted on the first micturition in the morning following the administration of the dye. They occurred, as a rule, immediately after micturition and never lasted longer than five to ten minutes. The burning sensation around the anus was temporary and was never noticed after more than one or two bowel movements following administration of the dye.

Since the analysis of this series of cases, we have used the single dose technic routinely, primarily from an economical standpoint and secondarily to simplify our procedure for the wards. Either may be used, however, with only minor discomfort for the patient.

#### ROENTGEN FINDINGS

Table II shows the results in 163 consecutive cases with the three technics. The concentration of dye was good in 126 cases. Gallstones were demonstrated in 13 cases in the entire series.

The gallbladder shadow was slightly less dense with the single and divided dose technic than when the double dose was used. Nevertheless, the concentration was satisfactory with either method and, as previously stated, we have adopted the single dose technic as a routine procedure. In 12 questionable cases, in which the single dose was used, the examination was repeated by the double dose technic without obtaining any additional information. We consider the re-examination by the double dose technic unnecessary.

Abnormal gastric acidity has no apparent effect upon the absorption and con-

centration of Priodax. A fractional gastric analysis with histamin was done in 81 per cent of the cases, with the following findings: free hydrochloric acid 0-70, with a total acidity from 0-101. Among these cases 5 per cent showed a definite hyp acidity, and 5 per cent showed a definite hyperacidity. The rest were normal or about normal. Excellent concentration was noted in two cases of achlorhydria.

Gastroscopic examination was done in 2 patients of the double dose group at the time of the roentgen examination. Both showed a normal orange-red gastric mucosa with no evidence of irritation by the Priodax, which was administered the night before. This suggests that the gastro-intestinal irritation is temporary.

Out of the entire series, 94 per cent showed a detectable amount of dye in the colon. In none of these was it sufficient to obscure the gallbladder. Gas in the colon seems to be less frequent than we have previously observed with the use of tetraiodophenolphthalein as a contrast medium for cholecystography.

#### OPERATIVE FINDINGS

Cholecystectomy was done in 10 cases, in all of which gallstones were present. In 2 of these operated cases no gallbladder shadow was obtained. In one other case with failure to concentrate the dye exploration was done and a relatively normal gallbladder was found. This patient, however, had an icterus index of 44 and clinical jaundice.

A second series of 63 patients has been analyzed for the operative findings. Thirty-nine were normal and 24 presented evidence of gallbladder disease. Twelve of the latter group have been operated on and all had cholecystitis and cholelithiasis.

This gives a total of 22 correctly diagnosed and verified cases of gallbladder disease out of 226 examinations. There are, of course, other cases, as shown in Table I, where gallstones have been demonstrated but the diagnosis not confirmed by cholecystectomy.

#### SUMMARY AND CONCLUSIONS

1. Priodax was used for cholecystography in 226 patients and appeared to be superior to tetraiodophenolphthalein.

2. The toxic symptoms were analyzed in 163 cases with the double dose, divided dose, and single dose technic. Diarrhea, nausea, and vomiting were infrequent.

3. The gallbladder was never obscured by unabsorbed dye.

4. Cholecystectomy confirmed the roentgen findings in 22 of 226 examinations.

5. A gallbladder found to be apparently normal at laparotomy was not visualized in a patient with clinical jaundice.

6. The single dose technic is most satisfactory.

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## CASE REPORTS

### Spontaneous Cholecystoduodenal Fistula in a Patient with a Primary Hepatoma of the Liver<sup>1</sup>

MAJOR RAPHAEL POMERANZ, M.C., MAJOR HUGH  
G. GRADY, M.C., MAJOR MATTHEW PEELAN,  
M.C., and CAPTAIN MAX MAGNES, M.C.

A case of spontaneous cholecystoduodenal fistula in a patient with a primary hepatoma of the liver is here presented because of several points of interest: (1) the relative rarity of these conditions, and particularly the combination of the two in one patient, (2) the roentgen demonstration and correct interpretation of the findings, as confirmed at autopsy, (3) the racial and geographical significance of primary hepatic cancer.

A 42-year-old corporal, a native of South America, was admitted to Winter General Hospital on Oct. 15, 1943, by transfer from a station hospital. He had entered the station hospital on Sept. 15, 1943, complaining of persistent dull epigastric pain. His appetite was good and there was no vomiting, although he had a sensation of obstruction in the stomach. There was no history of tarry or clay-colored stools. In 1938, the patient experienced an attack of severe epigastric pain which was relieved by a hypodermic injection. No diagnosis was made and he was comfortable up to the time of his admission, except for slight bloating lasting for a few minutes only. The blood findings, as determined at the station hospital, were: red cells, 4,200,000 and hemoglobin 89 per cent. Gastric analysis showed hyperchlorhydria. X-ray examination on Sept. 25 led to a diagnosis of possible diffuse gastric carcinoma or possible syphilis of the stomach. Since admission to the station hospital the patient had lost about twenty-five pounds in weight. He frequently had chills followed by elevation of temperature and profuse perspiration; he stated that he felt cold.

**Clinical Findings** (Captain Magnes): On examination, on Oct. 16, 1943, at Winter General Hospital, the patient appeared pale and weak. He moved slowly in bed as if he were in pain. On breathing, the lower right chest and upper right abdomen showed splinting; the upper abdomen seemed slightly distended. The lungs and heart were normal. There was rigidity of the upper portion of the right rectus muscle on palpation, and below the xiphoid process on both sides a tender mass was

palpable. This seemed more marked on the right and extended about 4 inches below the xiphoid process. The entire liver was enlarged about 2 inches below the costal margin.

**Laboratory Findings** (Oct. 18): Red blood cells, 4,300,000; white blood cells, 10,000; hemoglobin, 13.8 gm. Occult blood in the feces, 3+. Total gastric acidity, 49.0; free hydrochloric acid, 45.0; no lactic acid. Van den Bergh test: direct, none; indirect, 0.47 mg. Urine negative.

**Roentgen Findings** (Major Pomeranz): Radiographic and fluoroscopic study (Oct. 19) showed an orthotonic stomach of fair size, definite hypersecretion, good peristalsis throughout, and no defects. The duodenal cap showed no defects. The liver was enlarged. Fluoroscopic observation, in the prone right oblique position, showed a semicircular, faint linear extension of barium near the superior portion of the duodenum. Spot films disclosed a linear streak of barium entering a negative shadow surrounding this area (Fig. 1). Examination at four hours showed a 5 to 7 per cent barium residue in the fundus of the stomach, at the lesser curvature, evidently resting against the left lobe of the liver; spotted barium residue in the pyloric antrum and at the site of the described negative shadow, outside of the duodenum; the bulk of the barium meal in the lower loops of the ileum and the colon. A *barium enema* revealed no organic lesion of the colon. A *Graham test* was done on Oct. 25. With the divided dose method (6 gm.), no definite shadow of the gallbladder was obtained either before or after the test meal. A recheck study of the stomach and duodenum, after positioning of the patient in the prone right lateral and oblique positions, showed slow penetration of the barium fluid into the gallbladder area, definitely pointing to the presence of a fistula.

The roentgen observations were summarized as follows: Spontaneous cholecystoduodenal fistula between the superior portion of the duodenum and gallbladder, evidently pathological; possible stone in the cystic duct of the gallbladder, obstructive. An underlying malignant lesion of the biliary tract could not be ruled out. The liver was enlarged.

**Clinical Course:** In view of the above findings, and because of continued chills and fever (up to 104°), the patient was referred to the surgical department for exploration. The surgeon suspected that, in addition to the above findings, there was a right subhepatic abscess, secondary to the biliary fistula.

**Operative Findings** (Major Peelan): Operation was done Nov. 5, 1943. A four-inch incision was made parallel to the twelfth rib, the periosteum was incised, and the twelfth rib removed up to its neck. The rib bed was then divided transversely and the peritoneum was stripped forward until the

<sup>1</sup> Accepted for publication in April 1944.

liver was reached. Definite nodules, like those of carcinoma, could be palpated on the liver, but no evidence of abscess was found. The wound was closed in routine manner. The patient was then placed on his back, and an upper right rectus incision was made. A small amount of straw-colored fluid in the peritoneal cavity was observed. On exploration, the right lobe of the liver showed multiple small metastatic areas. The left lobe was

jaundice, which continued to increase. On Nov. 27, there was a definite change for the worse, and edema of the right leg developed, extending upward in a few hours to involve the entire thigh. Death occurred on Nov. 28, 1943. There was no fever after the first ten days following operation.

*Autopsy Findings* (Major Grady): The skin and sclerae were deeply jaundiced. The right lower extremity from the groin to the ankle was edematous,

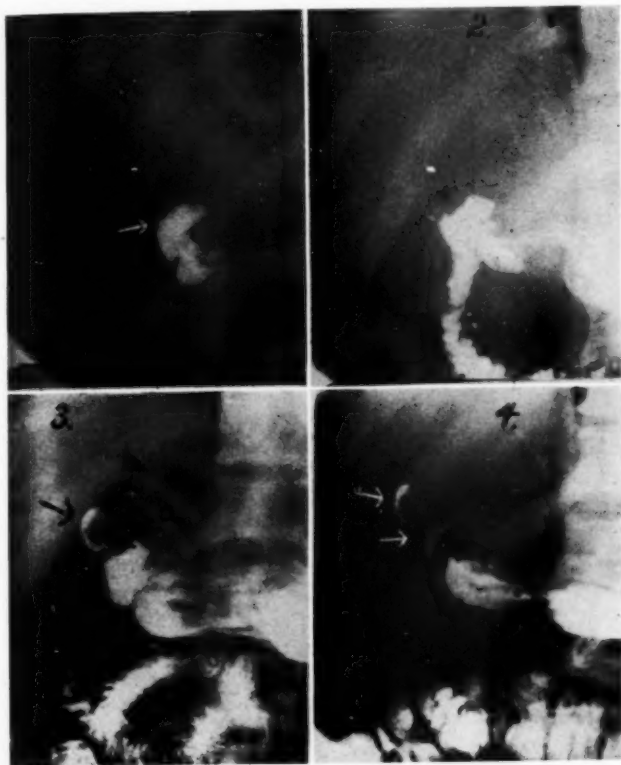


Fig. 1. Four successive views taken at five- to fifteen-minute intervals, showing successive stages of penetration of barium through the fistulous tract around the gallstone. a. Fistulous tract. b. Stone in gallbladder.

firm and hard throughout. The gallbladder was fixed in a firm mass. The stomach and duodenum, as well as the remainder of the abdomen, appeared normal, except for several enlarged pre-aortic nodes and fixation of the gastrohepatic ligament. One of the liver nodules was removed for biopsy, and the liver wound was reapproximated. The biopsy report was secondary adenocarcinoma of the liver. The primary site of the tumor could not be determined histologically.

*Postoperative Course:* The wounds healed by primary intention, but the patient grew weaker day by day. On Nov. 15, he began to show evidence of

being at least one-half as large again as the left extremity. Internal examination revealed 200 c.c. of blood-tinged amber fluid in the peritoneal cavity. Both lobes of the liver were adherent to the diaphragm, and the lesser curvature of the stomach was adherent to the inferior surface of the left lobe of the liver. The omentum was adherent to the parietal peritoneum in the right upper quadrant at the site of the recent surgical incision.

The heart weighed 210 gm. The myocardium was flabby and red-brown. The aorta, which was of normal width, showed in its abdominal segment lightly streaked and flecked orange-yellow athero-



Fig. 2. Gross specimen of stomach, duodenum, and gallbladder. A. Stomach. B. Duodenum. C. Wood applicator inserted in fistulous tract.

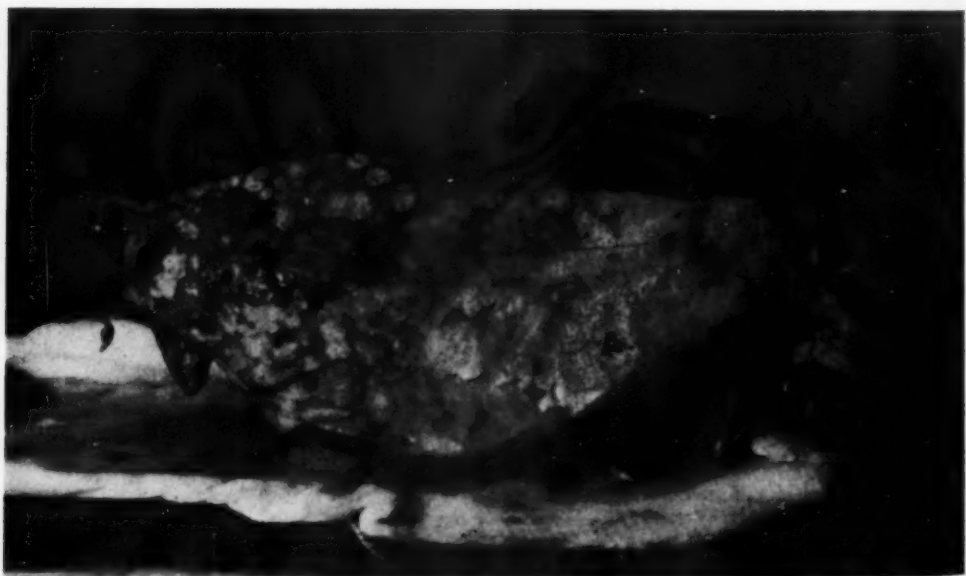


Fig. 3. Cross section of liver. A. Solid mass of tumor, left lobe. B. Tumor nodules, right lobe. C. Intervening liver parenchyma.



matous deposits. The right external iliac vein was distended and filled with lightly adherent, firm gray-red thrombus, which extended down into the femoral vein.

In the *lungs*, at the extreme base of the right lower lobe, was evidence of a pulmonary infarct measuring 1.8 cm.  $\times$  3 cm. The pulmonary artery leading to this area was plugged by an embolus 5 mm. long. The pleural surface of the right lung was slightly thickened and roughened by old fibrous adhesions.

The *stomach* was of normal size, but the lesser curvature was tightly adherent to the posterior sur-

The enlargement involved both lobes, the left relatively more than the right. The inferior border of the right lobe extended 7 cm. below the costal margin. The surface was irregular and studded with innumerable, slightly raised, round to oval tumor nodules ranging from 3 to 8 mm. in diameter. On section (Fig. 3), the right lobe was seen to be the seat of innumerable such nodules of firm, sharply demarcated, pale yellowish tumor tissue. The inferior two-thirds of the left lobe and the medial portion of the right lobe were replaced by a solid mass of similar tumor tissue with numerous dis-

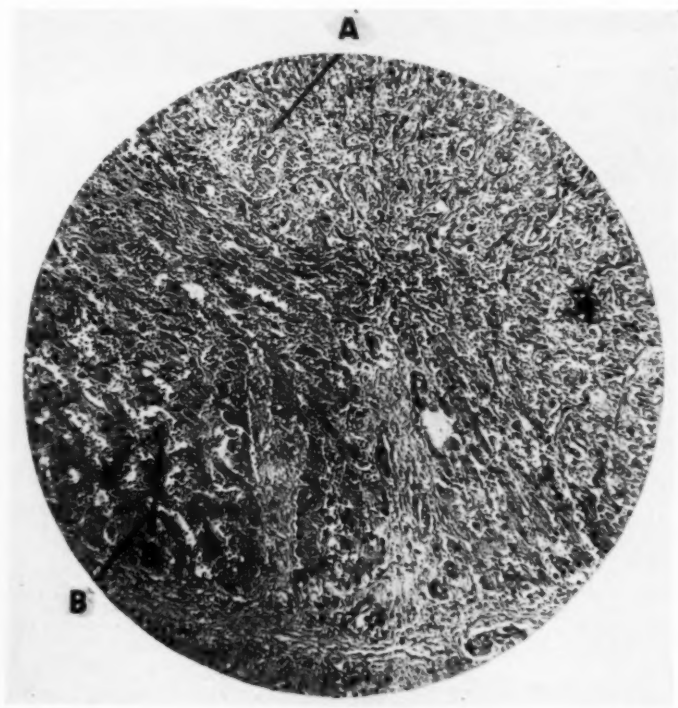


Fig. 4. Microscopic section of liver ( $\times 100$ ). A. Cords of tumor cells. B. Intervening liver cells.

face of the left lobe of the liver. A line of cleavage was present and the two organs could be separated cleanly. Otherwise, the stomach wall and its mucosa were normal. The *duodenum*, in the first and second portions, was adherent to the hepatic fissure and the gallbladder. At the junction of the first and second portions, on the right lateral border, was a 3-mm. oval fistulous communication (Fig. 2) with the fundus of the gallbladder. The stoma had smooth edges, and both it and the adjacent mucosa were free of tumor. The papilla of Vater appeared normal. The rest of the small intestine and the colon were normal.

The *liver* was greatly enlarged, weighing 4,050 gm.

crete tumor nodules in the superior third of the left lobe. The intervening hepatic parenchyma was firm, greenish brown, with moderately well preserved lobular markings. There was no evidence of cirrhosis. The portal vein at its entrance into the liver, and its main branches, for a few centimeters within the liver, were plugged with friable gray-red thrombi, lightly adherent to the intimal surface.

The *gallbladder* was imbedded in the median fissure of the liver, and the fundus was adherent to the second portion of the duodenum. The serosal surface, when dissected free, was thickened and light gray. The lumen contained a solitary mulberry-surfaced calculus, 6  $\times$  14 mm., but no bile. There

was no gross evidence of tumor. The cystic duct appeared normal. The common duct contained a friable black calculus, the size of a split pea, lying loosely at the ampulla of Vater. The mucosa was light yellow and free of tumor. The nodes at the neck of the gallbladder and about the common duct were enlarged up to  $0.8 \times 2.8$  cm. and were firm, dry, and pale yellow. A similar retroperitoneal para-aortic node at the level of the first lumbar vertebra was noted.

The adrenals were of normal size and shape. In

seat of severe inflammatory reaction. There were many engorged capillaries and a heavy infiltration of plasma cells with smaller numbers of lymphocytes and fibroblasts.

The para-aortic and cystic lymph nodes were almost wholly replaced by tumor. The tumor cells were growing in cords, sheets, and in some areas as acini. There was extensive necrosis.

There was secondary adenocarcinoma of both adrenals.

*Diagnosis:* Myocardial degeneration. Right ex-

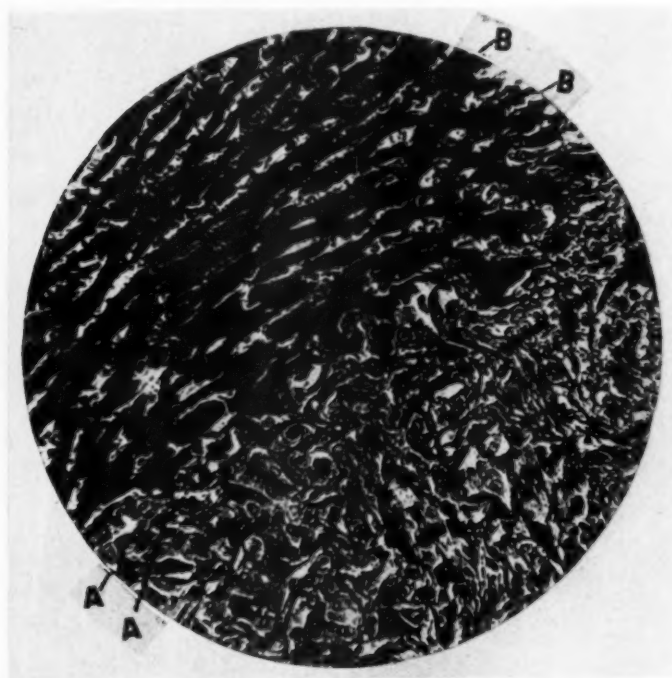


Fig. 5. Microscopic section of liver ( $\times 300$ ). Connective-tissue stain. A. Tumor cells. B. Intervening liver cells.

the medulla of each were two sharply defined, pale gray metastatic nodules, 1 to 2 mm. in diameter

*Microscopic Examination* (Figs. 4 and 5): Sections of the liver showed extensive replacement by tumor, which varied in morphology. In some areas it was composed of cords of large polygonal cells with large nuclei and prominent nucleoli, with a finely granular or vacuolated cytoplasm. In such areas there was a definite resemblance to liver cell cords. In other areas, the tumor formed clear-cut acini lined by cuboidal or columnar tumor cells. No "brush border" could be recognized. There was a considerable degree of necrosis. Mitotic figures were numerous. Growth was highly invasive. Sections showed the gallbladder adherent to the liver and free of tumor. The mucosa was extensively ulcerated and was the

ternal iliac venous thrombosis. Hemorrhagic infarction, right lower lobe. Pulmonary arterial thrombosis and embolism, postoperative. Primary adenocarcinoma of the liver. Chronic calculous cholecystitis. Cholecystoduodenal fistula, spontaneous. Portal venous thrombosis. Secondary adenocarcinoma of both adrenals and of the cystic and para-aortic nodes.

#### COMMENT

(Major Pomeranz)

According to statistics quoted by Feldman, the incidence of spontaneous biliary fistulae is 0.4 per cent; 43 cases were found

in a series of 10,866 autopsies reported by Roth, Schroeder, and Schloth. The first example of spontaneous biliary fistula recognized by x-ray was reported by Hunt and Herbst in 1915 and was shortly followed by another case presented by Carman and Miller. Garland and Brown reviewing the literature up to 1942, found 90 cases of spontaneous internal biliary fistulae recognized by x-ray and later verified. They include in this number 5 cases of their own (out of 7) which were correctly diagnosed by x-ray and later verified by surgery or autopsy. Ninety cases do not appear many in view of the vast number of gastro-intestinal x-ray studies performed. The most common cause of these fistulae is chronic gallbladder disease with the formation of stones which perforate into the gastro-intestinal tract. This was the cause in our patient. The first inkling of the presence of the lesion in this case was obtained on fluoroscopic observation of the linear penetration of the barium outside the limits of the duodenal outline, in a semicircular fashion around a negative shadow, later interpreted as a stone.

Primary carcinoma of the liver is another lesion with a very low incidence. Ewing quotes reports by Orth and Hensemann, placing the incidence at 0.5 per cent of all cancers. Goldzieher and Bokay reported, among 6,000 cases, an incidence of 1.3 per cent in five years. A higher incidence of primary liver cancer has been reported in the Philippine Islands (1.4 per cent), in Africa, South America, and China, where the figure has risen to 6.9 per cent. The average incidence, based on all reports, is about 0.2 per cent (Lichtman). In our case, the cancer of the liver was suspected clinically only. I should like to call attention, however, to a roentgen symptom seen in this case on the four-hour film. This showed a "selective" barium residue at the lesser curvature of the gastric fundus, near the left lobe of the liver. The autopsy revealed that the lesser curvature of the stomach was adherent to the posterior under-surface of the left lobe of the liver; there was a line

of cleavage, and the gastric wall was separated cleanly. In my opinion, the impaired gastric motility with the "selective" residue was caused by the adhesion probably formed as a result of the rapid liver growth, approximation of the liver with the stomach, and the reactive peritoneal changes. This roentgen finding, which was ignored, could well have served as a diagnostic point indicating adhesions in this area, particularly in association with a rapidly growing and enlarged liver.

The case recorded combines two unusually rare pathological lesions. As far as we can determine, no report of a combination of these two lesions in one patient appears in literature. It is evident that the spontaneous biliary fistula preceded the neoplasm. How much the chronic infection of the biliary tract contributed to the development of the primary hepatic carcinoma, is a matter of speculation. It is probable that these two conditions developed independently. The case is also unusual in that microscopic study of the liver revealed no evidence of cirrhosis. This is associated with hepatomas in 85 per cent of the cases. Hereditary, geographical, and dietary factors may be taken into consideration, in view of the greater incidence of primary liver cancer in the southern hemisphere.

*Note:* Grateful acknowledgment is made of the co-operation of members of the professional staff of Winter General Hospital.

Winter General Hospital  
Topeka, Kans.

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## An Unusual Gastrocolic Communication<sup>1</sup>

MAJ. AMOS R. SHIRLEY, M.C., A.U.S.

Veterans Administration, Wood (Milwaukee), Wis.

A white male aged 48 years, previously well, experienced an attack of vomiting following a heavy meal, accompanied by severe pain, slight abdominal distention, and a feeling of stiffness in the abdomen. He described the vomited material as of a brownish color and a foul odor. In view of the subsequent observations in the hospital it would appear to have been fecal in character. He did not seek medical advice, however, until about two weeks later, having had several less severe attacks in the interval.

The patient appeared underweight and undernourished but had no immediate complaints. He gave no history of gastrointestinal disease or of any abdominal complaints; he had never been operated upon, had always had a good appetite, and, so far as he knew, had never vomited blood or experienced rectal bleeding. In spite of his apparent emaciation, he stated that he had lost no weight up to the initial attack of vomiting two weeks earlier and only a little since that time. There was no palpable mass, and no tenderness could be elicited over any part of the abdomen. The left upper quadrant, however, was firm to pressure.

Examination of the digestive tract following a barium meal showed a most unusual communicating tract between the stomach and colon, approximately 11 cm. in length, lying in the left half of the abdomen. The upper part of this tract, which was filled with barium, was triangular in form, measuring approximately 7 cm. across and 4 cm. in depth. The remainder of the tract, which continued to join the transverse colon in the region of



Fig. 1. Roentgenogram showing (A) triangular segment of stomach, (B) the narrow tract between it and the remainder of the stomach, (C) the surrounding ring of carcinomatous tissue, (D) continuation of the gastrocolic fistula, and (E) the point of communication with the transverse colon.

the splenic flexure, had a maximum width of about 3.5 cm. In its middle lateral third was a small hook-like projection of barium. In the stomach itself there was a clearly demonstrable filling defect in the nature of a slightly ragged indentation along the greater curvature, involving also the cardiac and pyloric regions. Only a narrow channel remained through which barium passed into the triangular portion of the tract leading to the colon.

The possibility that the triangular collection of barium represented a part of the stomach, separated from the remainder of the organ by a segmenting type of carcinoma was immediately suggested. The question as to the nature of the distal portion of the communicating tract was puzzling. It was believed that it might be a fistulous tract, though its outline was more sharply defined than would be expected. If it were, indeed, a fistula, the problem of its origin remained. Was it due to canali-

<sup>1</sup> Accepted for publication in March 1944. Published with permission of the Medical Director, Veterans Administration, who assumes no responsibility for the opinions expressed or conclusions drawn by the author.

zation through neoplastic tissue? Or was it a pathway through a mass of adhesions subsequent to an abdominal abscess or peritonitis? As stated above, there was no palpable mass such as would be expected in the presence of a large carcinoma, though there was a firmness to pressure over the abdomen. No part of the communicating tract showed a mucosal pattern identical



Fig. 2. The six-hour roentgenogram showing gastric retention.

with that of the stomach, small bowel, or colon. On the other hand, there was a decided similarity in the appearance of the almost completely emptied stomach and the almost completely emptied tract.

From the gastrocolic tract the barium passed to the right, through the transverse colon and hepatic flexure, into the ascending colon and cecum. None was observed to pass to the left, and there was no demonstration of the descending colon, iliac colon, sigmoid, or rectum, up to and including the ninety-six-hour roentgenogram.

The findings at successive examinations following the barium meal may be briefly



Fig. 3. Barium enema study, showing the rectum, sigmoid, and descending colon, structures which were not revealed by the barium meal. There is still slight retention of the barium meal in the stomach, gastrocolic fistula, and transverse colon. The barium administered by enema did not reach into the stomach or extend through the transverse colon.

summarized. The *six-hour film* showed gastric retention and filling of the fistulous (?) tract and the right two-thirds of the transverse colon, the ascending colon, and cecum. There was also a considerable amount of barium within the loops of the ileum low in the median third of the pelvis. The picture was thus one of gastric retention, with two exits from the stomach—one through the communicating tract and the other through the pyloric canal and duodenum.

The *twenty-four-hour film* showed moderate retention in the stomach, duodenum, the communicating tract, terminal ileum, right half of the transverse colon, and ascending colon and cecum, with the merest suggestion of a descending colon.

At *forty-eight hours* a small amount of barium was adherent to the mucosa of the stomach and of the gastrocolic tract. The character of the deposition of the barium



in the tract was identical with that in the adjacent portion of the stomach, lending further support to the impression that at least the upper portion of the tract was actually part of the stomach cut off as the result of a carcinoma or possibly a benign neoplasm.

At *ninety-six hours* there was a trace of barium in the gastrocolic tract and in the transverse and ascending colon, cecum, and appendix.

Immediately following the ninety-six-hour examination a barium enema was given. The barium passed readily through the rectum, sigmoid, and descending colon up to a point corresponding to the junction of the gastrocolic tract with the transverse colon. During a fifteen-minute fluoroscopic observation not enough barium passed this point to be demonstrable. Nor did roentgenograms made immediately after the fluoroscopic examination or one hour later show more than a trace of barium in the transverse colon beyond the obstruction. Thus, while barium passed readily from the stomach through the communicating tract, none could be made to pass in the opposite direction, up through the tract into the stomach, indicating a valve-like action in the region of the junction between the gastrocolic tract and the colon. The upper border of the barium within the loop of the splenic flexure adjacent to the lower end of the gastrocolic communication was somewhat ragged in character. The descending colon, sigmoid, and rectum showed no filling defects.

In view of the observations described above, several possibilities entered into consideration: (1) gastric carcinoma with ulceration; (2) a slowly perforating or seeping non-malignant peptic ulcer with fibroid tissue reaction and fistula formation; (3) a left intra-abdominal abscess, perirenal or otherwise, with subsequent

fibroid tissue reaction and development of a fistula; (4) an anomaly, which appeared rather unlikely.

At operation the stomach was found to be the seat of a neoplasm 10 to 12 cm. in diameter, involving the greater curvature, the gastrocolic omentum, and the mid-portion of the transverse colon. Within this large, firm, nodular growth was the gastrocolic fistula previously demonstrated roentgenologically. The part of the stomach corresponding to the ragged indentation at the greater curvature seen roentgenologically showed a broad ring-like band of carcinomatous tissue running parallel to the curvature. It was this band that accounted for the appearance of segmentation in the roentgenogram. Within it lay that section of the communicating tract connecting the large upper part of the stomach with the lower and smaller triangular portion, which in the roentgenogram appeared to constitute the upper part of the unusual gastrocolic fistula. The patient died on the day of operation, one month following the first appearance of symptoms.

Microscopic study of a section of the stomach showed a transition of mucosa into atypical areas that invaded all layers, with mitotic figures. The tumor tissue was found to be markedly glandular in type at a distance from the site of origin of the tumor. The diagnosis was adenocarcinoma grade 4.

It is interesting to speculate as to how long this carcinoma with its unusual fistulous tract had been in the process of growth before the establishment of communication with the colon. In the absence of any symptoms referable to the digestive system up to two weeks before examination, this question must remain unanswered.

Veterans Administration  
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# EDITORIAL

Howard P. Doub, M.D., Editor

John D. Camp, M.D., Associate Editor

## The Roentgen Examination in Surgical Conditions of the Lungs

The Gargantuan strides of the thoracic surgeon, taken largely during the past decade, present a real challenge to the roentgenologist. The feasibility of surgery, not only for symptomatic relief or palliation but for the cure of a host of pulmonary diseases, especially tuberculosis, pulmonary abscess, actinomycosis, bronchiectasis, lung cysts, and tumors, has now been thoroughly tested and largely accepted. The recent observation of the successful extirpation of an entire lung from an infant of six months for the cure of an expanding lung cyst, which had reduced the vital capacity to a point almost incompatible with life, gives adequate evidence of the accomplishments of thoracic surgery. The statistical studies of the operative mortality from lobectomy and pneumonectomy are possibly even better witnesses. The problems of anesthesia particularly, but also of blood loss and the control of intrapleural and intrapulmonary pressures, have been largely overcome, while the surgical technic has been perfected to an astonishing degree.

There remain the problems of early diagnosis so that the surgeon may be afforded some opportunity of success, of differential diagnosis so that a radical operation is not attempted for improper indications, and of the delimitation of the pathological process so that the surgery is restricted to the minimum amount compatible with a complete cure.

The answer to these problems lies largely in the field of thoracic roentgenology. It is true that the freedom with which bronchoscopy is now used and the increased ability of the pathologist to inter-

pret bronchial biopsies have added immeasurably to pulmonary diagnosis, especially in lung tumors. Newer methods of sputum examination, differential bronchospirometry, careful assessment of vital capacity, and pressure determinations by means of paracentesis of the pleura, or of cavities within the lung, whether tuberculous or non-tuberculous, have added much to the armamentarium of the student of pulmonary pathology. Nevertheless, the major contributions to the problems of thoracic diagnosis are the responsibility of the roentgenologist.

Fortunately roentgenologic technics, at least to some degree, have kept abreast of the advances in thoracic surgery. It is a far cry from the customary routine stereoscopic postero-anterior films of the chest made in the upright position in deep inspiration to the present complex procedures which are usually necessary in studying the chronic diseases of the lungs for the cure of which radical surgery must be used. In such cases, the roentgen examination should consist of a number of steps, systematically approached. Ideally, the first procedure should be the fluoroscopic examination, which may well serve as a scouting expedition. While there is no doubt that small lesions may not be discovered in this way, it is usually a gross lesion which requires surgical attention. The opportunity to study the lungs in full inspiration and full expiration, with the patient rotated into every possible obliquity, or from lordosis to kyphosis, in order that the abnormal areas may be struck tangentially by the roentgen rays, is virtually impossible to obtain in any other manner.

From such a study information is obtained which indicates the nature and location of the abnormality and prescribes the positions in which roentgenograms are to be made. Too much emphasis cannot be placed upon the selection of the exact position which will best demonstrate the lesion. A slight obliquity may enable the clear visualization of a calcified plaque or the edge of a shallow cyst which might otherwise completely escape detection; the position of lordosis may demonstrate an atelectatic right middle lobe not otherwise clearly seen. Likewise, a change in position from upright to supine, from prone to lateral decubitus, may determine unequivocally the presence of fluid within the pleural cavity or within an intrapulmonary cavity. Aside from cases in which the presence of a foreign body in the bronchus is suspected, roentgenograms in the expiratory phase of respiration are too often not obtained, although these may be crucial in the early diagnosis of intrabronchial tumors. In addition, the use of a grid may help to clarify conditions within a dense lung.

At this point, it may be possible to predict accurately the nature of the lesion and its extent; enough may have been accomplished to make further studies unnecessary. More commonly, particularly in the case of lesions obstructing the bronchi or involving them extensively, further examinations must be undertaken. Body-section roentgenography, whether it be by planigraphy or laminagraphy, should be the next step. By this means the presence of an obstructing mass in the bronchus, its nature and location, may be ascertained. The presence of cavities in the lung, the determination of their extent, and the detection of an accompanying tumor may thus be elucidated. Furthermore, masses, calcified or otherwise, about the bronchi, at the bifurcations, and in the mediastinum are often localized in sectional roentgenograms.

If the information as to the nature and extent of the lesion is still not sufficiently

exact, bronchography with iodized oil should be undertaken. The presence of an obstructing lesion of the bronchus, some information as to whether it is neoplastic or inflammatory, its exact location and extent may be verified. Particularly in the case of bronchiectasis or cystic disease of the lungs, the distribution and extent of the lesions may best be mapped out by bronchography. It is important to make certain that the process is confined to one lobe or another, or to a part of one lobe and a part of another, in order that the surgeon may succeed in extirpating all of the abnormal areas or, contrariwise, to demonstrate that surgery is not feasible at all.

Finally, during the course of lung surgery on the operating table, and for some days thereafter, repeated roentgenograms of the chest may be necessary to determine accurately the degree of pneumothorax or hydrothorax and the amount of mediastinal displacement or compression of the contralateral lung, in order that remedial measures may be promptly undertaken to counteract the serious effects of excessive displacement of the mediastinum.

The addition of the findings obtained by these various roentgen procedures to the information available from the history, physical examination, and from the special procedures enumerated above, may permit very accurate conclusions as to the nature and extent of a surgical lesion of the lung in the majority of instances.

There remain, nevertheless, many unsolved problems. Further efforts in the direction of more accurate differentiation of the neoplastic or inflammatory nature of a peripheral nodule or of a cavity in the lung, of a tuberculous from a non-tuberculous lesion, of an infected cyst or a pulmonary abscess from an encapsulated pocket in the pleura, are still imperative. By and large, however, the improvement in roentgen diagnosis has followed closely upon the improvement in thoracic surgery. Both have resulted in a considerable reduction in the mortality from pulmonary disease.

LEO G. RIGLER, M.D.

## ANNOUNCEMENTS AND BOOK REVIEWS

### THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

The Radiological Society of North America announces the following officers for 1944-45: President, Lewis G. Allen, M.D., Kansas City, Kans.; President-Elect, Lowell S. Goin, M.D., Los Angeles, Calif.; First Vice-President, Sydney J. Hawley, M.D., Danville, Penna.; Second Vice-President, Robert R. Newell, M.D., San Francisco, Calif.; Third Vice-President, John S. Bouslog, M.D., Denver, Col.; Secretary-Treasurer, Donald S. Childs, M.D., Syracuse, N. Y.; Librarian, Howard P. Doub, M.D., Detroit, Mich.

Members of the Board of Directors are Frederick W. O'Brien, M.D., Boston, Mass., *Chairman*; James J. Clark, M.D., Atlanta, Ga.; Edgar P. McNamee, M.D., Cleveland, Ohio (to fill the unexpired term of Dr. Davis Spangler, resigned); Warren W. Furey, M.D., Chicago, Ill.; Lewis G. Allen, M.D., Kansas City, Kans.; Lowell S. Goin, M.D., Los Angeles, Calif.

### AMERICAN ROENTGEN RAY SOCIETY

At the recent meeting of the American Roentgen Ray Society the following officers were elected: President-Elect, Dr. Ross Golden, New York City; First Vice-President, Dr. Raymond C. Beeler, Indianapolis; Second Vice-President, Comdr. Harold Jacox, M.C., USNR, Great Lakes, Ill.; Treasurer, J. Bennett Edwards, Leonia, N. J.; Secretary, H. Dabney Kerr, Iowa City, Iowa.

At this meeting Dr. Lyell S. Kinney of San Diego, Calif., assumed the Presidency.

### A LETTER FROM OVERSEAS

The following paragraphs are from a letter recently received from a member of the Radiological Society of North America now in overseas service.

"I sometimes wonder how much the people back home realize what is being fought for over here, and an incident occurred the other day, associated with my radiological career, which I thought I would pass back to my associates in the RSNA in case any of them wonder, as I often have, what this business is all about.

"Many people back home will, of course, remember Dr. Solomon from L'Hôpital St. Antoine in Paris, who was one of the leading exponents of x-ray standardization in France and who represented that country at our last International Conference in Chicago. He was a dear friend of mine and I worked with him in Paris for a considerable period in 1931, during which time I grew to know his family quite well. He, of course, died in 1938 or thereabouts,

but upon passing through Paris recently, I tried to look up the family and inquire as to their well being.

"Upon finding their home empty, I inquired of a next-door neighbor as to their whereabouts and from this person learned the following story: A few weeks after the entrance of the Germans into Paris, in 1941, a squad of German soldiers appeared at the Solomon home, seized the son (35 years old and a promising physicist), took him out into the court behind the house, shot him and left him there. A few months later, the daughter, age about 30, was similarly taken from home, along with a considerable number of other French women, and shot as a hostage for some act of sabotage which had been committed in Paris. At about the same time, the mother was seized and sent to a disposal camp (one of those spots when once entered, no one ever leaves alive). The home was taken over temporarily by some German officers, and later all of the contents were divided up among German officers and taken away.

"Of course, the Solomon family had committed a very grievous offense—they were Jews."

### ELEVENTH ANNUAL POSTGRADUATE DAY UNIVERSITY OF TOLEDO

On Nov. 3, 1944, the Medical Institute of the University of Toledo observed its Eleventh Annual Postgraduate Day, with a program dedicated to the memory of Dr. John Thomas Murphy, an alumnus of the old Toledo Medical College and a Trustee of the University at the time of his death.

As was fitting, the program was devoted to roentgenology. The speakers were Lt. Col. Joseph C. Bell, Percy Jones Hospital, Battle Creek, Mich., Col. B. R. Kirklin, of the Mayo Clinic, now serving as Chief Consulting Roentgenologist, Office of the Surgeon-General, A.U.S., and Dr. U. V. Portmann of the Cleveland Clinic.

A "Memorial to Doctor Murphy" was delivered by Dr. F. M. Douglass of Toledo at the opening of the evening session.

### DR. GEORGE A. UNFUG HONORED

RADIOLOGY records with pleasure the choice of a member of the Radiological Society of North America, Dr. George A. Unfug, of Pueblo, Colo., as the new President-Elect of the Colorado State Medical Society. Doctor Unfug is also a member of the American College of Radiology and a diplomate of The American Board of Radiology. Of him the *Rocky Mountain Medical Journal* says: "He will be one of the youngest members ever to be elected President, and is held in high regard professionally and personally by all who know him."



### DIRECTORY OF MEDICAL SPECIALISTS

Certain changes in the *Directory of Medical Specialists* have been announced for the Third Edition, to appear in 1945. They are published here to assist diplomates of the American Board of Radiology who may be preparing their history for this new edition.

"The biographic data of the first two editions of the *Directory of Medical Specialists* included only position (internships, residencies, or assistantships) held during the course of training of men up to the time of their certification by the American Boards, and hospital and medical school staff positions then currently held.

"It is desired to extend these data in the Third Edition to include all formal hospital and medical school appointments, with dates held, even though now resigned, as well as records of all military service including commissions and dates, either in World War I, peace-time in the Reserve forces, or in the present war.

"Thus, a chronologically complete sketch of a diplomate's career is to be included in this Third Edition of the *Directory*.

"Membership or fellowship in national or sectional (not local) special societies, and national general societies with offices held, and dates, in any of these should be reported.

"Membership in recognized international medical societies may be included, but honorary or other membership in foreign medical societies should not be reported.

"Reference to the Second Edition (1942) of the *Directory* may be made for lists of medical societies to be included in one's biographic sketch.

"Families or secretaries of men absent in military service are asked to complete or correct previous listings or new forms being mailed to those eligible for inclusion in the *Directory*. Only those certified by an official American Board can be included, and there is no charge for this listing."

Communications should be addressed to The *Directory of Medical Specialists*, 919 North Michigan Ave., Chicago.

### Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

The 1944 YEAR BOOK OF RADIOLOGY. Diagnosis, edited by CHARLES A. WATERS, M.D., Associate in Roentgenology, Johns Hopkins University;

Assistant Visiting Roentgenologist, Johns Hopkins Hospital; Associate Editor, WHITMER B. FIROR, M.D., Assistant in Roentgenology, Johns Hopkins University; Assistant in Roentgenology, Johns Hopkins Hospital (on leave with the Armed Forces). Therapeutics, edited by IRA I. KAPLAN, B.Sc., M.D., Director, Radiation Therapy Department, Bellevue Hospital, New York City; Clinical Professor of Surgery, New York University Medical College. A volume of 448 pages, with 363 illustrations. Published by The Year Book Publishers, Chicago, Ill. Price \$5.00.

PUBLICACIONES DEL CENTRO DE INVESTIGACIONES TISIOLOGICAS. Director: PROF. ROQUE A. IZZO. Volumen VII. Pabellon "Las Provincias." Hospital Tornu. Buenos Aires, 1943.

### Book Reviews

THE GASTRO-INTESTINAL TRACT. A HANDBOOK OF ROENTGEN DIAGNOSIS. By FRED JENNER HODGES, B.S., M.D., Professor of Roentgenology, University of Michigan Medical School, Ann Arbor, Michigan. A volume of 320 pages, with numerous illustrations. Published by The Year Book Publishers, Inc., 304 S. Dearborn St., Chicago, Ill. Price \$5.50.

This volume is the second in a series of handbooks of roentgen diagnosis which are being published by the Year Book Publishers. It follows the general plan of the preceding volume, the descriptive material being condensed but amply illustrated with excellent cuts.

The book is divided into six sections: The Esophagus, The Upper Gastro-Intestinal Tract, The Biliary Tract, The Colon, The Abdomen Generally, and Findings of Particular Interest. At the beginning of each section are listed the conditions to be discussed in that section. The descriptions, though brief, are adequate for a handbook of this type. Some clinical information is included, together with clues to differential diagnosis. The author draws on his wide experience to include helpful hints for those less familiar with the subject. The cuts alone are invaluable, as an atlas.

The volume comprises 320 pages with 604 figures, of which 121 are full-page plates. A short bibliography is given at the end of each section, and an adequate index is appended.

This Handbook is highly recommended to students and roentgenologists, as well as to gastroenterologists and surgeons, as presenting an excellent summary of an important subject.



## RADIOLOGICAL SOCIETIES OF NORTH AMERICA

*Editor's Note.*—Will secretaries of societies please co-operate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

### UNITED STATES

*Radiological Society of North America.*—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse 2, N. Y.

*American Roentgen Ray Society.*—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

*American College of Radiology.*—Secretary, Mac F. Cabal, 540 N. Michigan Ave., Chicago 11, Ill.

*Section on Radiology, American Medical Association.*—Secretary, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

### ARKANSAS

*Arkansas Radiological Society.*—Secretary, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

### CALIFORNIA

*California Medical Association, Section on Radiology.*—Secretary, Earl R. Miller, M.D., University of California Hospital, San Francisco, Calif.

*Los Angeles County Medical Association, Radiological Section.*—Secretary, Roy W. Johnson, M.D., 1407 South Hope St., Los Angeles. Meets second Wednesday of each month at County Society Building.

*Pacific Roentgen Society.*—Secretary, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Meets annually during meeting of California Medical Association.

*San Diego Roentgen Society.*—Secretary, Henry L. Jaffe, M.D., Naval Hospital, Balboa Park, Calif. Meets first Wednesday of each month.

*San Francisco Radiological Society.*—Secretary, Martha Mottram, M.D., Suite 1789, 450 Sutter St., San Francisco. Meets monthly on third Thursday at 7:45 p.m., in Toland Hall, University of California Hospital, from January to June; at Lane Hall, Stanford University Hospital, July to December.

### COLORADO

*Denver Radiological Club.*—Secretary, A. Page Jackson, Jr., M.D., 304 Republic Bldg., Denver 2. Meetings third Friday of each month at the Denver Athletic Club.

### CONNECTICUT

*Connecticut State Medical Society, Section on Radiology.*—Secretary, Max Climan, M.D., 242 Trumbull St., Hartford 3. Meetings bimonthly, second Thursday.

### FLORIDA

*Florida Radiological Society.*—Secretary-Treasurer, Charles M. Gray, 306 Citizens Bldg., Tampa 2.

### GEORGIA

*Georgia Radiological Society.*—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta 3. Meetings twice annually, in November and at the annual meeting of State Medical Association.

### ILLINOIS

*Chicago Roentgen Society.*—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago 12. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

*Illinois Radiological Society.*—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

*Illinois State Medical Society, Section on Radiology.*—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago 12.

### INDIANA

*The Indiana Roentgen Society.*—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis 7. Annual meeting in May.

### IOWA

*The Iowa X-ray Club.*—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

### KENTUCKY

*Kentucky Radiological Society.*—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

### LOUISIANA

*Louisiana Radiological Society.*—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

*Shreveport Radiological Club.*—Secretary-Treasurer, R. W. Cooper, 940 Margaret Place. Meetings monthly on the second Wednesday, at the offices of the various members.

### MARYLAND

*Baltimore City Medical Society, Radiological Section.*—Secretary, Walter L. Kilby, M.D., 101 W. Read St., Baltimore 1. Meets third Tuesday of each month.

### MICHIGAN

*Detroit X-ray and Radium Society.*—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

*Michigan Association of Roentgenologists.*—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

### MINNESOTA

*Minnesota Radiological Society.*—Secretary, A. T. Stenstrom, M.D., Minneapolis General Hospital, Minneapolis 26. Meetings quarterly.

### MISSOURI

*Radiological Society of Greater Kansas City.*—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

*The St. Louis Society of Radiologists.*—Secretary, E. W. Spinzig, M.D., 2646 Potomac St. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

### NEBRASKA

*Nebraska Radiological Society.*—Secretary, F. L. Simonds, M.D., 1216 Medical Arts Bldg., Omaha 2. Meetings third Wednesday of each month at 6 p.m. in either Omaha or Lincoln.

### NEW ENGLAND

*New England Roentgen Ray Society* (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—Secretary-Treasurer, George Levene, M.D., Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

## NEW JERSEY

*Radiological Society of New Jersey.*—Secretary, H. R. Brindle, M.D., 501 Grand Ave., Asbury Park. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

## NEW YORK

*Associated Radiologists of New York, Inc.*—Secretary, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

*Brooklyn Roentgen Ray Society.*—Secretary-Treasurer, Leo Harrington, M.D., 880 Ocean Ave., Brooklyn 26. Meets fourth Tuesday of every month, October to April.

*Buffalo Radiological Society.*—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday evening each month. October to May, inclusive.

*Central New York Roentgen Ray Society.*—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse 10. Meetings are held in January, May, and October, as called by Executive Committee.

*Long Island Radiological Society.*—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

*New York Roentgen Society.*—Secretary, Ramsay Spillman, M.D., 115 E. 61st St., New York 21, N. Y.

*Rochester Roentgen-ray Society.*—Secretary, Murray P. George, M.D., 260 Crittenden Blvd., Rochester 7. Meetings at convenience of committee.

## NORTH CAROLINA

*Radiological Society of North Carolina.*—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

## NORTH DAKOTA

*North Dakota Radiological Society.*—Secretary, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

## OHIO

*Ohio Radiological Society.*—Secretary, Henry Snow, M.D., 1061 Reibold Bldg., Dayton 2. Next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

*Cleveland Radiological Society.*—Secretary-Treasurer, Don D. Brannan, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

*Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).*—Secretary-Treasurer, Samuel Brown, M.D., 707 Race St., Cincinnati 2. Meetings held third Tuesday of each month.

## PENNSYLVANIA

*Pennsylvania Radiological Society.*—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport 8. The Society meets annually.

*The Philadelphia Roentgen Ray Society.*—Secretary, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia 4. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

*The Pittsburgh Roentgen Society.*—Secretary-Treasurer, Lester M. J. Freedman, M.D., 4800 Friendship Ave., Pittsburgh 24, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

## ROCKY MOUNTAIN STATES

*Rocky Mountain Radiological Society* (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—Secretary, A. M. Popma, M.D., 220 North First St., Boise, Idaho.

## SOUTH CAROLINA

*South Carolina X-ray Society.*—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

## TENNESSEE

*Memphis Roentgen Club.*—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

*Tennessee Radiological Society.*—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

## TEXAS

*Texas Radiological Society.*—Secretary-Treasurer, Herman Klapproth M.D., Sherman.

## VIRGINIA

*Virginia Radiological Society.*—Secretary, E. Latané Flanagan, M.D., 215 Medical Arts Bldg., Richmond 19.

## WASHINGTON

*Washington State Radiological Society.*—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

## WISCONSIN

*Milwaukee Roentgen Ray Society.*—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee 3. Meets monthly on second Monday at the University Club.

*Radiological Section of the Wisconsin State Medical Society.*—Secretary, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

*University of Wisconsin Radiological Conference.*—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison 6, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

## CANADA

*La Société Canadienne-Française d'Electrologie et de Radiologie Médicales.*—General Secretary, Origène Desfréne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

## CUBA

*Sociedad de Radiología y Fisioterapia de Cuba.*—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

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## ROENTGEN DIAGNOSIS

### THE HEAD AND NECK

**The Morgagni-Stewart-Morel Syndrome. Report of a Case with Pneumoencephalographic Findings.** Matthew T. Moore. Arch. Int. Med. 73: 7-12, January 1944.

The triad of hyperostosis frontalis interna, obesity, and virilism was described originally by Morgagni in 1765. Stewart, in 1928, added the clinical feature of a psychosis to the syndrome, and Morel, in 1930, gave the first account of the condition in a living person, bringing the group picture of calvarial hyperostosis and endocrine, metabolic, and neuropsychiatric manifestations into clearer relief as an entity. Sherwood Moore's study of numerous roentgenograms of the skull (Am. J. Roentgenol. 35: 30, 1936) revealed that among 6,650 specimens four types of calvarial hyperostosis could be distinguished: hyperostosis frontalis interna, nebula frontalis, hyperostosis calvariae diffusa, and hyperostosis frontoparietalis, in the order of frequency named. He defined a symptom complex which later he termed "metabolic craniopathy." The entire syndrome has eventually been broadened to include the original concept of Morgagni, that of Stewart and Morel, and the signs and symptoms described by subsequent authors.

In the main, the syndrome consists of the following elements: one of the types of calvarial hyperostosis described by Moore; endocrine and metabolic disturbances, such as obesity, virilism, and menstrual disorders in female patients and gonadal deficiency in male patients; hypertension, and neuropsychiatric manifestations, such as headaches, cranial nerve defects (disturbance in olfaction, seventh nerve palsy, diplopia, amblyopia), fatigability, muscular weakness, narcolepsy, convulsive seizures, inco-ordination, dizziness, staggering gait, attacks of sweating, disturbances of speech, mental dullness, defects of memory, changes in personality, irritability, mental deterioration and, terminally, dementia. It is not essential, however, that all of these manifestations, with the exception of the pathognomonic roentgen finding of hyperostosis interna, be found in an individual case.

The syndrome may readily be confused with other endocrine or neuropsychiatric disorders, especially psychoneuroses, dementia paralytica, multiple sclerosis, and brain tumor. The author reports a case which was for many years dismissed as a harmless psychoneurosis, illustrating the failure to recognize the condition over a long period because of its slowly progressive and apparently innocuous nature. The patient was a 39-year-old woman presenting the syndrome of calvarial hyperostosis with metabolic, endocrine, and neuropsychiatric disturbances. Pneumoencephalograms (reproduced in the paper) showed evidence of cerebral degeneration in the form of frontoparietal cortical atrophy, atrophy of the islands of Reil, asymmetry of the lateral ventricles, and moderate internal hydrocephalus.

In view of the fact that the Morgagni-Stewart-Morel syndrome often occurs in incomplete patterns, the author suggests that the cerebral changes occur at a slow and irregular rate, *pari passu* with the metabolic craniopathy, and reflect a reaction of the individual tissues to an altered metabolic state. When the craniopathy and endocrine manifestations predominate and no

overt psychoneurosis or psychosis exists, then the Morgagni appellation is given; if, in addition, neuropsychiatric disorders appear, the Stewart-Morel designation is attached.

**Cervical Syringomyelia and Syringomyelia-Like States Associated with Arnold-Chiari Deformity and Platybasia.** Ben W. Lichtenstein. Arch. Neurol. & Psychiat. 49: 881-894, June 1943.

Although roentgenological procedures are not mentioned in this article, the subject matter is of interest to roentgenologists who employ aerographic methods in studying central nervous system lesions. The organic derangements of the brain and cord which may be found in association with developmental defects of the skull base and the upper cervical vertebrae are described and discussed.

Displacement of the structures of the hind brain into the upper portion of the spinal canal occurs frequently in platybasia. The fourth ventricle has been discovered as low as the fifth cervical vertebral segment. Vascular inadequacies resulting from traction or compression of vessels sometimes result in profound necrotic changes in nervous tissue and changes in cerebrospinal fluid dynamics may co-operate to produce a situation resembling syringomyelia.

It is well for roentgenologists to bear in mind the likelihood of associated or at least coexistent neurological disease when the film signs of platybasia are observed.

DEPARTMENT OF ROENTGENOLOGY  
UNIVERSITY OF MICHIGAN (F. J. H.)

**Agenesis of the Corpus Callosum with Possible Porencephaly: Review of Literature and Report of a Case.** A. T. Bunts and J. S. Chaffee. Arch. Neurol. & Psychiat. 51: 35-53, January 1944.

Agenesis of the corpus callosum is a rare anomalous condition of the brain which may be demonstrated encephalographically. Bunts and Chaffee review the 14 cases in the English literature in which an antemortem diagnosis of this anomaly has been made and add an interesting case of their own associated with a possible porencephalic cyst.

The salient encephalographic signs encountered in agenesis of the corpus callosum are best seen in sagittal projections. They consist of pronounced separation of somewhat dilated lateral ventricles, elevation and dilatation of the third ventricle, and elongation of dilated interventricular foramina. A so-called "bat-wing" configuration of the ventricular system may be produced. In lateral views, a peculiar "cocked-hat" appearance of the third ventricle and disproportionate dilatation of the posterior horns of the lateral ventricles may be seen.

The very important differential diagnosis between agenesis of the corpus callosum and cyst of the cavum septi pellucidi is discussed in detail. The outstanding differential point is that in cyst of the cavum septi pellucidi (fifth ventricle) the third ventricle is not significantly elevated.

An electroencephalogram was done in the case presented by the authors and, although the pattern was definitely abnormal, it could not be considered diagnostic.

DEPARTMENT OF ROENTGENOLOGY  
UNIVERSITY OF MICHIGAN (J. H.)



### THE CHEST

**Pulmonary Tuberculosis in Wellington: A Radiological Investigation Among Office and Factory Workers and Secondary School Children.** Marie Stringer Buchler. *New Zealand M. J.* 43: 73-81, April 1944.

The results of a survey of 2,204 males and females from factories, offices, and secondary schools are reported. The ages ranged from fourteen to over sixty years. The survey was carried out under the auspices of the New Zealand Department of Health. It was originally intended to use the Mantoux test as a screen and to examine positive reactors with 14 × 17-inch film. It was later decided to abandon the Mantoux test and use miniature films, since this was found to be less expensive, less time-consuming, and a more popular procedure.

Transport to the hospital where the examinations were made was provided to help insure participation and facilitate rapid examination. All examinations were made on 35-mm. film with a Contax III camera with F 1.5 lens, and Patterson fluoroscopic screen. Factors used for an average chest (20 cm.) were as follows: tube-screen distance 36 inches; 76 kv. p.; 120 ma.; 3/10 seconds.

All persons showing pathological changes were notified to report for further examination, with 14 × 17-inch films.

The results are tabulated according to sex, age groups, and occupation. Also the incidence of tuberculosis found in workers in various types of industry is tabulated, but the groups are generally too small to have statistical significance.

A total of 95 persons were referred for examination with 14 × 17-inch film, and 87 were requested to report to the chest clinic for special examination. The incidence of tuberculosis among all females in industry was 2.6 per cent, among clerical and school workers 2.8 per cent, among males in industry 4.9 per cent, and among male clerical workers 2.0 per cent. The incidence of active pulmonary tuberculosis was 0.6 per cent.

H. H. WRIGHT, M.D.

**Diagnosis of Bronchiectasis in Young Adults. Prebronchographic Roentgen Manifestations Observed Among Military Personnel.** William A. Evans, Jr. and Leon J. Galinsky. *Am. J. Roentgenol.* 51: 537-547, May 1944.

Bronchiectasis has been the most common chronic pulmonary condition at the station hospital from which this report comes. The soldier's history as revealed by response to questioning proved in general to be unreliable and the roentgen data therefore assumed an especially prominent role in raising the suspicion of bronchiectasis.

The material upon which the report is based consisted of 95 cases in which bronchograms had been made and prebronchographic roentgenograms were available for examination. In this series a slowly resolving bronchopneumonia was observed in 28 of the 37 cases with frank bronchiectasis, in 14 of the 24 with minimal or questionable bronchiectasis, and in 11 of the 34 in which no bronchographic evidence of bronchiectasis was obtained. A frequent but less definite and reliable sign of bronchiectasis was the accentuation of the bronchial markings in the basal and peripheral lung fields. This is especially significant when observed just above the diaphragm and in the costophrenic sul-

cus. A less common but nevertheless dependable sign of bronchiectasis was a pneumonia recurring in the same area of the lower lung fields after an interval of a few weeks or months. Another type of change noted was the occasional occurrence of a shrunken, contracted area in the basal or lower medial lung fields. Bronchographic examination showed dilated bronchial radicles closely packed against the mediastinum or the dome of the diaphragm.

Analysis of results revealed that bronchiectasis as demonstrated by bronchography could be predicted with reasonable accuracy from a study of the prebronchographic roentgenograms. A fairly close correlation was obtained in 32 cases with frank bronchiectasis, in 21 with minimal or questionable bronchiectasis, and in 26 where no bronchiectasis was discovered. There was a tendency to suspect bronchiectasis somewhat more frequently than confirmation could be obtained bronchographically. It seems advisable, therefore, to seek bronchographic confirmation of a diagnosis of bronchiectasis, however strong the suspicion for such a diagnosis may have been from previous clinical roentgen studies.

CLARENCE E. WEAVER, M.D.

**Prevention of Bronchiectasis.** Louis H. Clerf. *Pennsylvania M. J.* 47: 676-680, April 1944.

Iodized oil has played an important role in the detection and mapping of areas of bronchial dilatation in the lungs. While extirpation of a lobe is sometimes an effective cure, it can be used only in selected cases and is of no help to a large group who are poor surgical risks.

Although a congenital form is described, bronchiectasis is most commonly caused by bronchial obstruction with atelectasis and infection. Thick secretions are the most common cause of bronchial obstruction in children. A foreign body lodged in a bronchus for a period of time will cause certain residual pulmonary changes and bronchiectasis may be an end-result. The degree of change is in proportion to the amount of obstruction, its duration, and the amount of infection that exists.

Whenever there is a question as to the cause of bronchial obstruction, roentgen examination and bronchoscopy should be done and appropriate treatment instituted.

JOSEPH T. DANZER, M.D.

**Boeck's Sarcoid and Systemic Sarcoidosis (Besnier-Boeck-Schaumann Disease): Study of 35 Cases.** David Reisner. *Am. Rev. Tuberc.* 49: 289-307, April 1944.

This, the first of two articles on the subject, deals primarily with clinical and roentgen observations of Boeck's sarcoid and systemic sarcoidosis, based on a study of 35 cases in which the clinical diagnosis could be substantiated by histologic examination of one or more biopsy specimens. Seven of the patients died in the course of observation and 4 of these came to autopsy. There were 11 males and 24 females in the series; 30 of the patients were Negroes and 5 were white, this preponderance of the Negro race being out of proportion to the racial composition of the total population of the institutions from which the material was drawn. The youngest patient was eight years old but the majority were between twenty and twenty-nine years. It thus appears that the disease occurs chiefly in young adults, which is in agreement with the experience of others.

While available evidence indicates that sarcoidosis is essentially a widespread disseminated disease, the systemic character is not always manifest clinically. In the more common cases pulmonary involvement and associated systemic lymphadenopathy represent the most conspicuous clinical findings. Such involvement may occur, also, in association with lesions in various other organs, as the eyes, lacrimal glands, parotid glands, spleen, liver, etc. One of the most prominent and constant clinical features of sarcoidosis is involvement of the lymph nodes in various parts of the body, and this was observed to a greater or less degree in all cases of this series. Of the peripheral nodes, those in the cervical, axillary, and inguinal regions were most commonly involved. Involvement of the intrathoracic lymph nodes is a most striking finding and usually exceeds in degree the enlargement of the peripheral nodes. Thirty of the cases in this series showed definite roentgen evidence of such mediastinal node enlargement. The involvement is usually bilateral and often symmetrical, ranging in extent, as seen roentgenographically, from a moderately prominent mediastinal or hilar shadow to massive densities projecting for a considerable distance into the pulmonary field. Such lymph node involvement in general causes no subjective local symptoms or physical signs. In some instances dyspnea of varying severity and, on occasion, wheezing may be present. The involved lymph nodes show a tendency to spontaneous regression, which is particularly striking in cases showing mediastinal adenopathy.

Involvement of the lungs occurred in all but two of the author's 35 cases. In a large proportion the pulmonary changes were discovered on routine chest roentgenograms, with no symptoms present referable to the lungs. At most, the symptoms were mild. Three types of pulmonary changes were observed: (1) Diffusely disseminated changes consisting of discrete small nodular foci resembling those in acute miliary or chronic forms of hematogenous tuberculosis. (2) Either diffuse or localized changes of a linear or strand-like character, giving rise to prominent root trunks and peripheral markings. These lesions are rather similar to the pulmonary changes observed in silicosis, in vascular congestion, and in lymphangitic carcinomatosis. (3) In five cases the pulmonary changes consisted of a patchy coalescent density having the appearance of conglomerate fibrotic induration, usually in combination with widespread changes of linear or discrete nodular character.

The type of lesion showing the most striking tendency to spontaneous regression was the disseminated nodular or miliary form. In about one-third of the cases, progression of the lesion in the lungs occurred during the course of observation. In 3 cases there was evidence indicative of the development of progressive caseous and destructive pulmonary tuberculosis which eventually resulted in a fatal termination. In some cases the pulmonary lesions remained stationary over a period ranging from two to ten years. These lesions were predominantly fibrotic in character. It seems evident, therefore, that during some phase of the disease the pathologic changes may be of a reversible nature and thus striking regression may occur. The variation in the roentgenologic appearance during the later phases of the disease appears to be due to varying degrees of fibrotic induration of the lung. In other instances transformation into frank tuberculosis occurs.

Seven case reports are included, with illustrative roentgenograms of the lungs. L. W. PAUL, M.D.

**Solitary Circumscribed Tumors of the Lung.** T. F. Thornton, Jr., W. E. Adams, and R. G. Bloch. *Surg., Gynec. & Obst.* 78:364-370, April 1944.

This report deals with a group of 23 cases characterized by single rounded pulmonary lesions arising in the smaller peripheral bronchi, measuring 2 cm. or more in diameter. Such tumors comprise about 25 per cent of primary lung neoplasms.

There is no typical symptomatology. Cough and hemoptysis are uncommon, each occurring in only 5 cases in the present series. Weight loss, anorexia, and weakness are important features, and chest pain is not infrequent, indicating the silent progression of the disease to a relatively advanced stage before medical advice is sought. Clubbing of the fingers was noted in 5 cases.

Physical examination is often negative, but may be of value in revealing a primary neoplasm responsible for a solitary lung metastasis or metastatic foci originating from a primary intrathoracic tumor.

X-ray examination discloses a solitary, dense, rounded, sharply circumscribed mass, occasionally with a fluid level. The appearance may be confused by proximity of the mass to the chest wall or mediastinum.

Of the 23 cases, 17 were malignant tumors, of which 14 were primary and 3 metastatic (2 from the kidney and one from the uterus). There was one benign tumor, a hemangioma. In 4 cases the lesion proved to be tuberculous, and in one a chronic abscess. Thus, most of the solitary "cannon-ball" tumors in this series were primary malignant tumors, chiefly carcinomas.

Preoperative diagnosis is extremely difficult. Only 11 of the 23 patients were admitted directly to medical or surgical chest clinics. In only 6 cases was there any certainty as to diagnosis before operation. The most common error was in the diagnosis of tuberculosis. However, the presence of calcium deposits should give a clue as to the tuberculous nature of the process. Every lesion was demonstrable by x-ray examination. Bronchography was helpful in several instances, but bronchoscopy yielded only 2 positive diagnoses in 12 cases so studied. The authors believe that exploratory thoracotomy is indicated because it provides accurate diagnosis and in suitable cases leads to immediate treatment. Diagnosis was established in 10 cases by this method.

The results of treatment are discouraging, as would be anticipated from the late onset of symptoms. Of the 17 patients with malignant tumors, only 2 are living and apparently well, one ten and one twelve months after surgery, despite the tendency of the primary carcinomas to be highly differentiated. This emphasizes the importance of x-ray examination of the chest in every case of unexplained weakness and weight loss, followed by early thoracotomy in those cases presenting a solitary tumor. JOSEPH SELMAN, M.D.

**Roentgenological Changes in the Esophagus in Tuberculous Mediastinitis.** Lloyd E. Hawes. *Am. J. Roentgenol.* 51:575-584, May 1944.

The differential diagnosis between mediastinal tumor and mediastinal infection is often difficult for the roentgenologist as well as for the clinician. The only

roentgenologic change may be widening of the mediastinal shadow without parenchymal lung disease. Examination of the barium-filled esophagus in addition to the usual chest roentgenograms has given promise of furnishing considerable differential aid. Five cases of active mediastinal tuberculosis are cited and in each case the value of esophageal study was confirmed.

In one case there was flattening of the esophagus with displacement and an irregular mucosal pattern. In another, roentgen examination revealed multiple adhesions to the esophageal wall and a short fistula into the mediastinum. Another patient showed narrowing of the esophagus with a large pressure defect from a mediastinal mass with adhesions to the wall and irregular mucosal pattern. In a fourth case involvement of the esophagus in the inflammatory process was shown by the intimate adherence of the esophagus to the left main bronchus, which produced a pressure defect. A fifth patient showed multiple fine adhesions of the esophagus at the level of enlarged nodes with some irregularity of the mucosal pattern and two small pressure defects.

Tuberculous mediastinitis usually develops from infection in the tracheobronchial lymph nodes, and infrequently from rupture of a tuberculous focus in the spine, sternum, pericardial or pleural cavity. Active pulmonary tuberculosis is the most frequent source. In older patients the cause may be the breaking down, or reactivation, of an old calcified or scarred mediastinal node. Tuberculous tracheobronchitis rarely gives rise to mediastinitis. After infection of the mediastinal connective tissue, the resulting adhesions and scars may pull upon and stretch the esophagus, or a scar or part of an inflammatory mass may wholly or partially encircle the esophagus and lead to stenosis or a small area of rigidity in its wall. Occasionally there is tubercle formation in the wall; ulceration and rupture into the esophagus may occur. The best known example of the effect of an adhesion on the esophagus is the traction diverticulum.

CLARENCE E. WEAVER, M.D.

**Pneumopericardium in a Forty-Two Day Old Infant.** D. J. Lages Netto. *Am. J. Dis. Child.* 67: 288-289, April 1944.

The author reports a case of pneumopericardium in a Negro female infant, associated with bronchopneumonia, demonstrated roentgenographically and proved at autopsy. A layer of air surrounded the heart, separating it from the pericardium. There were pneumonic foci in the lung parenchyma and two large abscesses in the right lower lobe. When the larger abscess, which was in intimate contact with the pericardium, was opened postmortem, it was noted to be in communication with a fairly large bronchial tube. This relationship probably explains the origin of the pneumopericardium.

Following a difficult delivery the child had received Vitamin K and 20 c.c. of blood injected intramuscularly into the buttock. A small abscess developed at the site of injection with eventual formation of a fistula extending into the rectum. Hematogenous spread of this infection was believed to be responsible for the subsequent pneumonia.

LESTER M. J. FREEDMAN, M.D.

**Foreign Bodies in and about the Heart.** Edward F. Bland. *Am. Heart J.* 27: 588-600, April 1944.

The author reports the clinical and roentgen findings in 4 of 8 patients from the North African war zone

with penetrating chest wounds and retained foreign bodies in or in close proximity to the heart.

In the first case a sharp-nosed bullet was embedded for two-thirds of its length (total 2.3 cm.) in the right side of the heart, either in the wall or in a greatly thickened pericardium. In the second case a metallic foreign body from an exploded antipersonnel mine lodged just above the apex of the heart, presumably in the wall of the left ventricle. The third patient was wounded by mortar shell fragments, and subsequent roentgen examination showed a rounded foreign body in the lung, about 1 cm. behind the heart, near the left auricle. In the fourth case multiple fragments in the heart wall and lung were traced back to a hunting accident seven years earlier, when the patient was shot in the chest. The bullet was removed at the time and the retained foreign bodies were believed to be bits of a zipper shattered by the impact of the missile.

Pericardial and pleural effusions developed in the first and second cases, but resolved. In the third case there was a transient pneumopericardium. The intracardiac foreign bodies were seen to move with the pulsations of the heart, while those within the lung moved with respiration.

Electrocardiograms revealed slight right axis deviation in Case 1, changes consistent with injury to the region of the cardiac apex in Case 2, and slight abnormalities in the T-waves in Case 3.

None of the foreign bodies was removed, but the course in each instance was favorable, indicating the ability of the heart to withstand physical injury and even to tolerate sizable slugs of metal within and adjacent to its walls.

The author briefly mentions 4 other cases: (1) a bullet lodged against the aorta; (2) two fragments in the heart muscle, one anteriorly in the region of the aortic orifice and one posteriorly near the junction of the left auricle and ventricle; (3) a jagged metallic fragment at the lower border of the heart, in the region of the right ventricle; (4) a fragment of metal in the right auricle.

HENRY K. TAYLOR, M.D.

## THE DIGESTIVE SYSTEM

**Correlation of Roentgenologic and Gastroscopic Examinations from the Standpoint of the Gastroenterologist.** R. J. F. Renshaw. *Am. J. Roentgenol.* 51: 585-591, May 1944.

The author has reviewed 938 consecutive gastroscopic examinations made on 842 patients. In 217 patients, or 25.6 per cent, the gastroscopic examination was of major value as compared to the roentgenologic. In 150 patients, or 17.7 per cent, the diagnosis was established by gastroscopy when other methods had failed. Most of these were cases of chronic gastritis. In 67 patients in whom the roentgenologist suspected gastric ulcer or cancer, the gastroscopist could state definitely that no organic disease was present. The gastroscopic examination was of secondary or confirmatory value in 55.4 per cent; it was of no value in 19 per cent. In 58 cases the gastroscopist failed to discover a lesion or an area where the roentgenologist suspected or demonstrated its presence.

Gastroscopy has certain definite limitations. The Schindler-Cameron gastroscope contains 54 lenses. If for anatomical reasons the instrument is flexed beyond 42°, the image is not transmitted from one lens to

the next. Esophageal or gastric spasm may render the examination incomplete. The gastroscopist sees a moving picture and what may be seen at one movement may not be visualized again. Gastroscopic blind spots include an area at the tip of the instrument, extending over the greater curvature; the lower anterior and posterior walls opposite the incisura angularis; the posterior wall of the body immediately adjacent to the instrument; the extreme upper portions of the lesser curvature; and a large portion of the fornix. Inconstant blind areas include the pylorus and lesser curvature of the antrum. In only 118 cases, however, was the examination totally unsatisfactory because of technical reasons. "Progress" or repeated gastroscopic examinations are often desirable, since an unsatisfactory examination on one occasion does not mean that all subsequent studies will be indeterminate.

A comparison of roentgenologic and gastroscopic diagnoses in a series of proved cases revealed that, while the roentgenologic examination is still the most valuable single examination, the gastroscopist is no more likely to make the correct diagnosis or to err in judgment than the roentgenologist. Likewise, in the matter of differentiating between a malignant and benign lesion, the gastroscopist is not superior to the roentgenologist.

Certain cases cannot be considered as having been adequately studied unless a gastroscopic examination has been done. The diagnosis of chronic gastritis is chiefly the gastroscopist's prerogative.

CLARENCE E. WEAVER, M.D.

**Congenital Atresia of the Esophagus, with Tracheo-Esophageal Fistula: Transpleural Operative Approach.** Albert O. Singleton and Maynard D. Knight. *Ann. Surg.* 119: 556-571, April 1944.

The authors have covered well a highly technical surgical problem, with a discussion of the various procedures suggested for its correction.

Esophageal anomalies are of three types: (1) complete absence of the esophagus, which is rare; (2) a blind upper and a blind lower segment, with no tracheal communication; (3) atresia associated with a fistulous opening into the trachea. This third type is further subdivided according as the fistulous communication is from the upper segment (type 3A), the lower segment (type 3B), or both (type 3C). Of the various types, 3B—a blind upper segment with a tracheal fistula from the lower segment—is most common, accounting for 70 to 80 per cent of all cases.

The symptoms are constant and diagnostic: drooling, with excessive amounts of mucus and saliva, and attacks of choking and cyanosis, precipitated by attempts at feeding. In types 1, 2, and 3A, a plain film of the abdomen shows absence of gas in the bowel, while in types 3B and 3C its presence can be demonstrated. Diagnosis is helped by introduction of a soft rubber catheter, which will encounter obstruction 10 to 12 cm. from the alveolar margin. Barium should not be used as a contrast medium. Lipiodol or diodrast may be employed and is essential for the diagnosis of types 3A and 3C; it should be aspirated, however, immediately after the films are made.

Associated anomalies, as for example imperforate anus, are common but are seldom incompatible with life.

The authors discuss the anatomical and embryologic aspects of these anomalies and review the literature of treatment, with its long record of failures. They favor a transpleural operation, with closure of the fistula and primary anastomosis of the two esophageal segments, when possible. When the length of the segments will not permit anastomosis, cervical esophagotomy and occlusion of the lower end are the next alternative. In either instance a preliminary gastrotomy should be done.

Four cases, all terminating fatally, are recorded. In two of these the authors employed the transpleural procedure. In one, in a premature infant, the distance between the segments of the esophagus proved too great for approximation of the ends. In the other, with a fistula from the lower segment, the operation was successfully completed and the child lived over seven months. The introduction of bougies over a silk thread was carried out after the third week in an attempt at dilatation. Unfortunately the thread was inadvertently cut at about seven months and an attempt was made to replace it by another, to which a small piece of lead was attached. Death followed as a result of pneumonia. Autopsy revealed a second fistula in the upper segment of the esophagus in which the piece of lead had become entangled, resulting in enlargement of the opening and the development of pneumonia. The authors believe that this fistula, had it been discovered earlier, might have been repaired without difficulty.

An interesting discussion follows this paper. In his remarks, Doctor Ochsner emphasizes the importance of operating through the right rather than the left hemithorax.

V. A. LOOKANOFF, M.D.

**Achalasia of the Esophagus.** Ralph F. Niehaus. *J. Iowa M. Soc.* 34: 145-148, April 1944.

Forty cases of achalasia of the esophagus were seen at the State University of Iowa Hospitals between 1929 and 1939. In 5 instances a malignant neoplasm was subsequently discovered, although on roentgen examination and esophagoscopy the condition was diagnosed as achalasia. This represents an error of 13 per cent.

The author stresses the importance of differentiating achalasia from carcinoma of the lower end of the esophagus or fundus of the stomach, and secondly, of excluding carcinoma as a complication in achalasia itself.

E. W. GODFREY, M.D.

**Gastric Emptying Time of Man at High and Normal Environmental Temperatures.** Austin Henschel, Henry Longstreet Taylor, and Ancel Keys. *Am. J. Physiol.* 141: 205-208, April 1944.

Gastric emptying times were observed on 17 normal men, eighteen to twenty-eight years of age, in rest at environmental temperatures of 77° F. and 120° F.

The subjects reported for examination in the morning without breakfast. After one-half hour of rest in air-conditioned rooms, a standard barium meal, consisting of 4 ounces of cooked oatmeal to which 2 teaspoons of sugar and 2 ounces of barium sulfate were added, was eaten as rapidly as possible. Five minutes after starting the barium meal the first x-ray picture was taken. The second film was taken at one hour and from then on the progress of the meal was followed by fluoroscopy at fifteen-minute intervals. Roentgenograms were taken whenever a decided change in the



size of the stomach shadow was observed. The final emptying time was confirmed roentgenographically. Examinations were made in the standing position. Between observations the subjects remained seated.

The gastric shadows were traced onto paper from the developed x-ray films, and the areas of the shadows were measured with a planimeter. All the gastric areas were expressed in per cent of the area at five minutes after taking the barium meal.

In all but one of the subjects the gastric emptying time was faster at the higher temperature. In 12 subjects the average decrease in emptying time was 30 per cent. Decreased appetite in hot weather, therefore, cannot be attributed to decreased gastric motor function. Observations on about 100 normal men doing hard work at 120° F. failed to indicate any lack of appetite or any signs of decreased gastric activity except in actual heat exhaustion.

#### **Hypertrophic Pyloric Stenosis in Adults.** Howard Wakefield. *Gastroenterology* 2: 250-257, April 1944.

A case is reported of hypertrophic pyloric stenosis in an adult with a long history of vomiting and nausea. X-ray examination revealed a stenotic lesion of the stomach, which was successfully resected.

The author quotes rather extensively from the literature and states that evidence is gradually accumulating which favors the view that in some cases the symptoms of pyloric stenosis of infancy may go on to adult life before they produce a serious problem, but it is not clear that this was true of his case. The greatest help in diagnosis is a history of nausea and vomiting of many years' duration plus x-ray studies of the stomach showing the long pyloric canal described by Kirklin. Histologic examination of the excised tissue is essential.

#### **Roentgen Visualization of Tumors of the Cardia.**

Milton G. Wasch and Bernard S. Epstein. *Am. J. Roentgenol.* 51: 564-571, May 1944.

The most reliable index for the correct diagnosis of tumors of the cardia is a clear demonstration of the tumor itself. Sometimes the existing stomach bubble is sufficient for this purpose. The authors have been able to produce contrast roentgenograms of the cardia by inflating the stomach through a Levin tube under fluoroscopic control, using the hand bulb from a blood pressure apparatus. The insufflation may be made with the stomach empty or partially filled with barium. Films are made in various positions. Precautions should be taken to avoid interpreting extraneous shadows as intrinsic gastric masses. Among these are the shadows of an overlying spine, of an enlarged left ventricle, a high retroperitoneal tumor, an exudate in the left lumbar region, and, in rare instances, an aneurysm of the upper abdominal aorta. An enlarged left lobe of the liver may offer some difficulty but may usually be identified by the smoothness of its borders, its lingual contour, and its continuity with the main hepatic mass.

Case reports and roentgenograms are furnished to illustrate some of the tumors of the cardia demonstrable by this method.

This paper serves to call to our attention the necessity of careful examination of the cardia and gives a helpful method of demonstrating lesions which can be and often are overlooked in routine gastric examinations.

CLARENCE E. WEAVER, M.D.

#### **Sarcoma of the Stomach.** Arthur E. Porritt, K. E. A. Hughes, and R. J. C. Campbell. *Brit. J. Surg.* 31: 395-398, April 1944.

A soldier, aged 27, gave a long history of gastric distress characterized chiefly by pain half an hour after meals. A large mass was visible and palpable in the left epigastrium and hypochondrium. There was a moderate secondary anemia and a fractional test meal revealed absence of free hydrochloric acid and traces of blood in each specimen. The roentgenographic examination was limited by the patient's intolerance of barium. The stomach was not freely movable and peristalsis was absent. The lesser curvature was irregular and the appearance suggested displacement forward and to the left. A well defined mucosal pattern supported a diagnosis of extragastric neoplasm and was against carcinoma of the stomach.

At operation a large gastric tumor of hard rubbery consistence was found involving the entire lesser curvature, adherent to the left lobe of the liver and spreading through the lesser peritoneal sac up into the transverse mesocolon. Pieces of the growth removed for pathological study showed round-cell sarcoma. An occasional spindle cell suggested an origin from muscle.

Death occurred seventeen days after operation and autopsy revealed involvement of almost the entire stomach, limited by the cardiac and pyloric orifices. The tumor was adherent to and appeared to be invading the left and caudate lobes of the liver and a perforation had occurred in this area, partially sealed off by the liver. Perforations are said to be more common than with carcinoma.

The abdominal lymph nodes were not involved with the exception of an isolated node in the transverse mesocolon. There were no hepatic metastases.

MAX CLIMAN, M.D.

#### **Errors in the Diagnosis of Intestinal Obstruction**

Robert N. Bartels and Karl S. Harris. *J. Iowa M. Soc.* 34: 138-142, April 1944.

Five cases presenting the characteristic symptoms and signs of acute mechanical intestinal obstruction are reported. In this group the history, clinical, and roentgen findings were all in accord with such a diagnosis, yet surgical exploration revealed no evidence of obstruction.

In the first case, a roentgenogram showed air and fluid levels in the small bowel. At operation a segment of small intestine appeared somewhat distended, edematous, and stippled on handling. Peristalsis was present in this region and the blood supply to the gut was normal. It is suggested that the obstruction was due to volvulus, with spontaneous release.

Roentgen examination of the second patient revealed dilatation of the small and large bowel with gas. At operation, four hours after the roentgenograms were taken, the small bowel was collapsed and normal. The authors suggest that this may be classified as intestinal obstruction due to enterospasm.

Films of the third patient, an elderly male, showed a greatly dilated colon and some small bowel dilatation, with evidence of fluid levels. At operation a diagnosis of annular carcinoma was made because of constriction and thickening at the rectosigmoid, and a cecostomy was done. The patient went rapidly downhill. At autopsy no obstructive lesion of the bowel could be found. This case is classified as obstruction due to colonic spasm.



In the fourth case roentgenograms revealed dilatation of the large gut. Following exploration the diagnosis was changed to megacolon.

Films of the last patient showed large bowel distention. A diagnosis of carcinoma of the sigmoid was made because of an obstructive lesion demonstrated by barium enema. At operation no lesion was found. This also was thought to be a case of intestinal obstruction due to colonic spasm.

While it is generally recognized that negative x-ray evidence in plain roentgenograms may not rule out the possibility of intestinal obstruction, the absence of operative findings in cases in which the history, clinical, and roentgen findings concur is unusual.

E. W. GODFREY, M.D.

**Small Intestinal Disorders in Avitaminosis.** Norman Learner, Herbert M. Stauffer, and Charles L. Brown. *Ann. Int. Med.* 20: 675-685, April 1944.

The authors review the experimental and clinical evidence presented by various authorities indicating that deficiency states are accompanied not only by disturbed gastro-intestinal motility but also by defective absorption of essential food factors and vitamins.

Mackie in 1933 (*M. Clin. North America* 17: 165, 1933) reported the roentgen findings in the small bowel in a case of non-tropical sprue, and these were established by subsequent investigators as a constant feature of the sprue syndrome. The changes, which tend to disappear with clinical improvement, consist in disturbed motility with accumulation of quantities of the contrast material in loops that appear dilated and smooth, the so-called "moulage" effect. Between these loops are segments empty of barium, giving the impression of alternating areas of reduced tonus and spastic areas. A striking feature of the more advanced cases is the presence of gas and fluid levels in the dilated loops, simulating intestinal obstruction.

More recently a similar roentgen picture has been observed in other deficiency conditions, and Lepore and Golden (*J. A. M. A.* 117: 918, 1941) have described a syndrome due to vitamin B deficiency characterized by reversible changes in the small bowel pattern. Radiologically, this "deficiency pattern" includes hypermotility and hypertonicity in the early stages; hypomotility and dilatation in the advanced cases; abnormal segmentation, and coarsening or obliteration of the mucosal pattern, with flocculation of barium.

Two cases illustrating the roentgen changes in deficiency states are presented. The first patient showed mild changes which improved upon therapy; in the second the changes were severe and apparently irreversible.

The roentgen picture of avitaminosis is not specific. Gastro-intestinal allergy may produce changes in intestinal motility, demonstrable by x-rays, as may emotional disturbances. Hypocalcemia may affect the small bowel pattern, and altered intestinal motility has been described in diabetes insipidus and nephrosis. Patients with portal cirrhosis or an obstructive carcinoma may also show an abnormal pattern. If the roentgenological changes are mild, they cannot be distinguished from normal variations, since no extended series of complete small intestinal studies in normal subjects has been published. Modifications in the pattern even of the same patient may occur from time to time under the influence of emotional or other

factors. Recent work has indicated, furthermore, that the healthy child may normally show a "deficiency pattern."

In spite of these obvious limitations to the dependability of the "deficiency pattern" as a criterion of vitamin B deficiency, the authors believe that patients with "functional" gastro-intestinal disorders in whom such a pattern is demonstrable should be given a trial of vitamin B therapy. This should be in the form of yeast by mouth and crude liver extract parenterally, with supplemental use of other components of the vitamin B complex.

A useful bibliography is appended.

STEPHEN N. TAGER, M.D.

**Annular Pancreas. A Tabulation of the Recent Literature and Report of a Case.** Bert E. Stoffer. *Am. J. M. Sc.* 207: 430-435, April 1944.

The incidence of annular pancreas is approximately one in every 2,500 autopsies. Less than 50 cases had been reported up to 1943. A new case, the third from the author's hospital, is here recorded.

A psychotic white male, aged 62, had been vomiting several times daily for six months prior to admission. Roentgen examination revealed an abnormality of the second portion of the duodenum which was interpreted as being due to a diverticulum. At autopsy an annular pancreas was found, causing an hour-glass deformity of the duodenum. The ring of pancreatic tissue was complete, although a small part was composed of fibrous tissue. As is usual in this condition, there was no apparent connection between the main pancreatic duct and the duct of the annular portion. This supports the theory that annular pancreas is an abnormal development of the ventral pancreatic anlage rather than a localized hypertrophy of a normally formed pancreas. Other congenital malformations, especially in the gastro-intestinal tract, are frequently associated. Cerebral malformations were found in the author's patient.

This case is the third of the seven reported in the past ten years in which an erroneous diagnosis of duodenal diverticulum was made. Usually the second and third portions of the duodenum are involved. A constriction at the involved site is the usual deformity.

BENJAMIN COLEMAN, M.D.

**Clinical Value of Cholangiography.** Dean Macdonald. *Can. M. J.* 50: 349-351, April 1944.

X-ray study of the biliary ductal system with the aid of a contrast medium is of value in obtaining information concerning calculi, strictures, and biliary fistulae. The author prefers diodrast 35 per cent, although a 17.5 per cent solution may be employed in thin patients. Hippuran was found to give too faint a shadow, while lipiodol was too heavy and thick, tending to "blot out" small calculi.

For delayed or postoperative cholangiography, the diodrast solution is heated to body temperature. After the withdrawal of bile, 3 to 10 c.c. of the solution, depending on the size of the common duct, are injected slowly into the drainage tube and barbotaged into the duct and radicals, with care not to introduce any air. The procedure is best done with the patient in the Trendelenburg position. Morphine (gr. 1/6) is sometimes given fifteen minutes or half an hour before the first film is made to increase the resistance of the sphincter of Oddi and prevent too rapid emptying.

Several exposures are made until filling is complete. The patient is then placed flat or in a reversed Trendelenburg position and given amyl nitrite inhalation. Three exposures are then made at intervals of thirty seconds, two minutes, and ten or fifteen minutes. If the gallbladder is still *in situ*, the patient should be rotated to prevent obscuring of the ducts by its shadow. Good emptying of the duct system does not exclude the presence of calculi, since a stone may be present without causing obstruction.

Roentgen examination during operation, or immediate cholangiography, is regarded by the author as the method of choice, at least theoretically, although in his experience it has not yielded the good results reported by others. It is especially valuable for the determination of residual calculi and in secondary operations where scarring and adhesions make digital examination of the common duct difficult.

LESTER M. J. FREEDMAN, M.D.

### THE PERITONEUM

**Post-Operative Pneumo-Peritoneum.** J. E. Bannen. *Brit. J. Radiol.* 17: 119-121, April 1944.

Pneumoperitoneum occurs to some degree after every laparotomy, the air usually being absorbed within seven days. With the patient in Fowler's position, the free air rises to the subdiaphragmatic regions and is demonstrated roentgenographically as an aerated space 1 or 2 inches in depth, separating the diaphragm from the liver and stomach. Frequently the upper pole of the left kidney can be clearly seen through the air-filled cupola of the left diaphragm. The clinical signs are few: cough, chest pain, and perhaps respiratory embarrassment, but these are not typical.

There are two probable causative factors of pneumoperitoneum following operation: the opening of the peritoneal space to air and the habit of many surgeons of pulling the abdominal wall up when putting in the last sutures, thus increasing the air content of the abdomen. Larger quantities of air are found after pelvic operations.

Pneumoperitoneum may be responsible for certain postoperative pulmonary complications, as it adds to the embarrassment of the already handicapped respiration. This is particularly true when the patient is in the Fowler position. So-called "gas pains" may be due to excessive air in the peritoneal cavity.

In making the diagnosis by x-ray, subdiaphragmatic abscess must be differentiated. This is usually unilateral; it may show a fluid level and an inflammatory zone in the adjacent lung.

SYDNEY J. HAWLEY, M.D.

### THE SKELETAL SYSTEM

**Neurofibromatosis of Bone.** Murray M. Friedman. *Am. J. Roentgenol.* 51: 623-630, May 1944.

Neurofibromatosis is characterized by a proliferation of the tissues composing the peripheral nerves, including both the axis cylinders and their sheaths. The overgrowth may take place along the course of the nerve, produce a general thickening of the nerves, or involve their peripheral terminations. Brooks and Lehman (*Surg., Gynec., & Obst.* 38: 587, 1924. *Abst. in Radiology* 3: 455, 1924) attribute the bone changes in this disease to the development of a neurofibroma in

one of the periosteal nerves. As the tumor enlarges, pressure is exerted on the bone cortex, causing erosion and pit formation. These depressions are filled with neurofibromatous tissue. In the roentgenogram they sometimes take on the appearance of cysts and at times a thin shell of cortex covers the fibrous tissue. No actual infiltration of the bone substance by neurofibromatous tissue has been demonstrated. The disease is considered to be hereditary in character. Nørgaard (*Acta radiol.* 18: 460, 1937) is of the opinion that differences in the length of bones can be accounted for on the basis of an embryonal defect, while Moore (*J. Bone & Joint Surg.* 23: 109, 1941) finds strong evidence that overgrowth is the result of a segmental relationship between the affected nerve and the bone. Scoliosis is found frequently in neurofibromatosis. This is a kyphoscoliosis, the usual site of which is the lower portion of the thoracic spine.

Four cases of neurofibromatosis with bone involvement are presented. Two showed pedunculated tumors of the skin. In one kyphosis was the principal bony abnormality. In another there were defects in the skull, scoliosis of the spine with erosion of the fifth lumbar segment, shortening of one leg, and widening of the tibial shaft by the formation of irregular cortical and subperiosteal new bone. The third case was a localized form involving the mandible. In a fourth patient there was unilateral involvement of the left half of the pelvis and bones of the lower extremity by an osteosclerotic process. The lower end of the femur was widened. The cortex of the shaft was thickened and there were cyst-like areas at the lower end of the shaft. The cortex of the tibia was thickened. This patient had a definite asymmetry of the face, body, and limbs. Neurofibromatous tissue was demonstrated in the marrow cavity of the femur, which suggests that nervous tissue must be present in bone marrow. Sclerosis of bone in the femur and tibia was thought to have been caused by neurofibromatous tissue in the marrow cavity as microscopic examination of the cortical bone showed no recognizable changes.

CLARENCE E. WEAVER, M.D.

**Symposium on Low Back Pain. Spondylolisthesis Analysis of 59 Consecutive Cases.** Guy A. Caldwell. *Ann. Surg.* 119: 485-494, April 1944.

While the author entitles his paper "Spondylolisthesis," he includes not only cases of forward slipping of the vertebra but also those defects of the neural arch in which slipping is not demonstrable (prespondylolisthesis or spondylolysis). As indicative of the frequency of these conditions as a cause of low back pain, he reports that, of 152 patients with the latter complaint, 10 per cent were found to have neural arch defects, while among 82 from the same group who were referred for orthopedic study after other causes had been ruled out, 18 per cent had spondylolisthesis or spondylolysis. The present report is based on a series of 59 cases seen in a period of twenty-two months. Twenty-seven of the group gave a history of trauma.

The physical findings in spondylolisthesis and spondylolysis vary. Typical shortening of the back, prominence of the buttocks and iliac crest, and abrupt stepping-off of the spine at the level of the spinous process of the fifth lumbar vertebra are present only in spondylolisthesis of grades III and IV. In none of the author's series, which included only cases of spondylolysis and spondylolisthesis of grades I and II, was displacement of

the vertebra sufficient to be recognized by inspection or palpation.

The diagnosis of these earlier cases is dependent upon the roentgen examination. This demands the most painstaking technic, with at least three views as a routine: (1) a direct anteroposterior view; (2) a true lateral view focused on the fifth lumbar vertebra; (3) a 35-degree anteroposterior view with the rays directed toward the head and centered between the sacrum and the fifth lumbar vertebra. For the confirmation of unilateral defects, a 45-degree oblique lateral film may also be required.

Of the author's 59 patients, 16 had spondylitis, and in 9 of these the defect was unilateral. Of the 43 cases of spondylolisthesis, 37 were of grade I and 6 of grade II.

The symptoms of spondylolisthesis have been attributed by most observers to progressive displacement of the vertebral body with consequent dragging upon the supporting muscles, ligaments, and nerve roots, though some few question this view. The author is among the latter group. He believes that progressive narrowing of the intervertebral disk with degenerative changes in the disk and proliferative bone changes in the neighborhood of the intervertebral foramina may explain all of the symptoms and signs generally seen.

Operative treatment, consisting in spinal fusion of various types, has in general been regarded as the most effective treatment. The author believes that conservative measures are worthy of more consideration. Among 23 of his series in which treatment consisted in the application of a brace or corset, without operation, the results after ten to eighteen months were "good" in 7, *i.e.*, the patient was relieved of pain while wearing the support and was able to perform light work; "fair" results were obtained in 12 (partial relief of pain only). Eight cases were treated by spinal fusion, with good results in 3 and fair in 1. The author favors a simplified type of operation, consisting in fusion of the lumbosacral articulation alone rather than an attempt to establish a bridge from the third lumbar vertebra to the sacrum with a bone graft. One case is reported in which there was sciatic pain, found to be due to incarceration of the nerve root in proliferated bone. From observation of this case it is concluded that when spondylolisthesis is associated with sciatic pain and roentgenograms reveal a narrow lumbosacral disk with marginal hypertrophic changes, the nerve root should be explored and decompressed when necessary.

The other paper in this Symposium, preceding that by Caldwell, is by Walter E. Dandy, who favors complete or essentially complete removal of the affected disks. An interesting Discussion follows (pp. 494-497).

V. A. LOOKANOFF, M.D.

**Diagnosis and Treatment of Spondylitis.** A. Raff. South African M. J. 18: 98-100, March 25, 1944.

The author classifies spinal arthritis in three broad groups. These are (1) spondylitis ankylopoietica, (2) rheumatoid spondylitis, and (3) spondylitis osteoarthritis.

Of the three types ankylosing spondylitis or spondylitis adolescents (Scott) is considered the most important. It attacks young and athletic men; the onset is slow and progressive and can be recognized five to seven years before the spinal symptoms have developed; it is amenable to treatment and arrest in its early stages. The first radiographic change is decalcification of the bones of the lumbar spine and pelvis. Clinically this corresponds to the stage of "wandering pains."

Later there are obliteration and sclerosis of the posterior and anterior fissures of the sacroiliac joints, sclerosis usually being a sign of high resistance. Subsequently pain and stiffness of the spine become constant features, and the radiographs show the characteristic changes of ankylosis of the spinal segments. The degenerative changes in the sacroiliac joints occur five to seven years before spondylitis. These constitute the "prespondylitis" of Scott, who maintained that if wide field x-ray therapy consisting of fractionated doses of 60-100 r, 1-3 mm. Al filtration, and 100-130 kv.p., is administered, the process can be arrested.

Rheumatoid spondylitis, which is of infectious origin, affects mainly women between the ages of twenty and forty. It is secondary to rheumatoid arthritis elsewhere. Women at the menopause complaining of painful "rheumatic back" and symmetrical swelling of the knees and small joints of the hands and wrists present diagnostic problems. They may be aided by intramuscular injections of ovarian extracts, but the author finds that this is often not enough. He advocates the infiltration of the painful areas with a local anesthetic, along with either local or wide field x-ray therapy for the obstinate cases.

Spondylitis of the osteo-arthritic type is a disease of advancing years and is more common in men. Osteophytes and exostoses with narrowing of the intervertebral spaces are a common finding. The sacroiliac joints are not involved.

Radiographs of the hands and sacroiliac joints, along with the blood sedimentation rate, are valuable in establishing the differential diagnosis and useful as a guide to the progress of the case and the response to treatment.

E. W. GODFREY, M.D.

**Lateral Rupture of the Intervertebral Discs: A Common Cause of Shoulder and Arm Pain.** R. G. Spurling and Wm. B. Scoville. Surg., Gynec. & Obst. 78: 350-358, April 1944.

The authors give an able discussion of the clinical syndrome associated with lateral rupture of the cervical intervertebral disks, basing their observations on a review of the literature and on direct study of 12 cases proved by operation at the Walter Reed General Hospital.

The cervical canal is more completely filled with nervous tissue than either the dorsal or lumbar spine; consequently, any intraspinal mass in that region causes early symptoms of pressure. Moreover, the cervical nerve roots emerge from the dura at right angles and lie immediately over the intervertebral disks so that a lateral protrusion of a disk may compress the root directly against adjacent structures without much damage to the spinal cord itself. The fact that the intervertebral foramina in the cervical region are relatively shallow in their anteroposterior diameters makes the roots especially vulnerable to pressure from small bony spurs or lateral herniations of the nucleus pulposus.

The points of greatest strain in the cervical spine are at the fifth and sixth interspaces, and the disks are frequently narrowed at these levels. Associated with these narrowed disks may be roentgenologic evidence of localized arthritis, but many patients with such x-ray findings have no symptoms referable to the neck or arms.

A history of injury is more frequent in cases in which

the ruptured disk produces actual cord compression than with small laterally placed lesions which cause only arm and shoulder pain. Degenerative processes may play an important part in formation of the lesions, as is indicated by the frequent presence of spurs and narrowing of the disks.

Pain and stiffness of the neck are usually the first symptoms and sometimes are of short duration. The sites of maximum pain are the base of the neck, tip of the shoulder, the arm down to the elbow, and the hand. The pain is often made worse by sudden movements or straining, and may be relieved by change of position. Numbness of the hand with weakness of the whole arm is frequently noted. Numbness and tingling of the hand may be recurrent, without any loss of sensation except in severe and prolonged cases. Pressing on the top of the head, tilted toward the affected side, may demonstrate or aggravate the symptoms described. Muscular weakness, usually of the biceps or triceps, may be present, and the tendon reflexes of these muscles may be weak or absent. There may be spinal tenderness at the site of the lesion and pressure there may reproduce the symptoms.

Neoplastic or inflammatory lesions of the cervical spine, or neoplasms arising in the nerve roots themselves, may give rise to a similar train of symptoms. Compression by the scalenus anticus of the lower portion of the brachial plexus, with or without cervical rib, is commonly confused with a ruptured cervical disk. In the former instance, however, the nerve pain and paresthesias are referred to the ulnar distribution of the eighth cervical and first thoracic instead of the distribution of the sixth or seventh cervical nerves, and since ruptured disks rarely occur below the level of the sixth interspace this serves as a means of differential diagnosis. In disk cases, furthermore, there is no evidence of compression of the subclavian artery. In doubtful cases compression of the neck by flexion toward the affected side with pressure on the head, as previously suggested, will bring out the characteristic symptoms of a disk lesion.

Lateral cervical spine films show narrowing of the intervertebral space, if present, and the oblique films bring out narrowing of the foramina and the presence of osteophytes. Pantopaque myelography is an accurate diagnostic procedure, satisfactory results being obtained following the injection of 6 c.c. of the opaque medium.

In minor cases conservative treatment may be considered, but if muscular atrophy or marked sensory loss is present in the arm, even though no signs of cord compression are present, prompt operative measures are indicated in order to prevent permanent damage to the cervical cord. Mild cases may be treated by a period of bed rest with halter traction, followed if necessary by use of a cervical collar support. Unless relief is obtained in three or four days, more radical measures will probably be necessary. Manipulation of the cervical spine in these cases is a dangerous procedure. Surgical treatment consists of removal of the herniated nucleus, together with any spurs which may be present. All of the authors' 12 patients were relieved of their symptoms within two weeks following operation and when completely healed were returned to military service without disability.

At the Walter Reed General Hospital one case of cervical disk rupture is found to 12 cases of lumbar disk rupture, but as clinical knowledge of the cervical lesion

becomes more widely applied this proportion is likely to change. The majority of patients with cervical disk lesions were over forty years of age, but age seemed of little significance in the lumbar cases. Only 16 per cent of the cervical cases gave a history of trauma, while in the lumbar group 60 per cent gave such a history. Pain and paresthesias radiating from the neck into the shoulder, arm, and hand, and exaggerated by the neck compression test, were found in all the patients with cervical lesions. In every instance the site was at the 5th or 6th cervical level. In one patient both the 5th and 6th disks were affected.

DEWAYNE TOWNSEND, M.D.

**Posterior Herniation of the Intervertebral Disc: An Analysis of 65 Cases.** Wm. T. Peyton and Jules D. Levin. *Minnesota Med.* 27: 263-272, April 1944.

The authors stress the necessity for follow-up studies in cases of herniation of the intervertebral disk to determine the effects of operation on the symptoms and physical signs. They limit their study to cases involving the lumbar spine. The periods of observation represented vary from eighteen months to five and one-half years. The series includes 65 cases in which laminectomy was performed.

The lesion occurs most frequently in the third, fourth, fifth, and sixth decades. In 50 to 77 per cent of cases, according to different authorities, there is a history of trauma. Outstanding among the physical findings are: loss of the lumbar curve; muscle spasm of the erector spinae group in the affected area; tenderness to deep pressure in the involved area; positive response to sciatic nerve-stretching tests; objective sensory changes.

Roentgenologically, narrowing of the intervertebral space may be demonstrable but this is not conclusive evidence of a herniated disk. Contrast material in the subarachnoid space is essential for definitive information, but this should be employed only after a careful neurologic examination. Lipiodol is the medium preferred; it should be removed after films are made.

The authors state that in recent years they have come to prefer hemilaminectomy or partial hemilaminectomy in the treatment of disk lesions, though in very large or mid-line lesions, bilateral total laminectomy is indicated. Recurrence of a herniated disk at the same site or at another site has been reported. Spinal fusion may sometimes prevent such a recurrence.

As to results, the authors found that backache was completely relieved in about 70 per cent of cases, and partially in another 20 per cent; sciatic pain, complained of in 96 per cent of the cases before operation, was present in only 27.5 per cent postoperatively; the lumbar curve was restored in about 34 per cent of cases; muscle spasm was relieved in about 70 per cent and root pain in an equal number. In other words, relief of major symptoms was obtained in something over two-thirds of the cases. PERCY J. DELANO, M.D.

**Neurosurgical Interpretation of Dermatomal Hypalgnesia with Herniation of the Lumbar Intervertebral Disc.** J. Jay Keegan. *J. Bone & Joint Surg.* 26: 238-246, April 1944.

From clinical and surgical experience with herniated lumbar intervertebral disks, the author has been able to outline definitely the dermatomes of the lower extremity. Contrary to the usual belief, each sensory



nerve has a distinct distribution, and its loss is definitely registered in the change in sensation along a determinable region.

The first sacral nerve, with an intraspinal length of 3 to 4 cm., is the one most frequently involved, as a result of herniation of the fifth lumbar disk. Herniation of the disk compresses this nerve between the ganglion below and the union with the main dural canal above, and hence is not necessarily demonstrable in a myelogram. The herniating disk first elevates and stretches the posterolateral portion of the posterior longitudinal intervertebral ligament, which may explain the early ache or pain in the lower back. The first contact with the nerve root is on the anterior portion, where the motor fibers are located, but it is the subsequent compression of the posterior aspect of the nerve against the ligamentum flavum or lamina which probably accounts for the sensory changes. The fact that the most dorsal sensory fibers of the root are those of the dorsal primary division supplying the mid-gluteal region and the sacroiliac ligament probably explains the constant gluteal pain in these cases and their confusion with sacroiliac disease.

When this nerve root has been compressed long enough or severely enough to produce subjective numbness, or loss of ankle jerk, there can usually be outlined a continuous strip of hypalgesia extending from the little toe to the upper sacral spine, with a small area of analgesia on the lateral border of the foot or on the posterolateral calf. This dermatome hypalgesia can be outlined sharply and is constant in its location; hence it is diagnostic for first sacral nerve-root loss, whatever the cause. It includes only the little toe; does not include the heel; covers the external malleolus; extends up the posterolateral calf, knee, and thigh, with its medial border about at the posterior mid-line; then curves slightly outward over the buttock and mid-gluteal region to the upper sacral spine, where it stops sharply at the mid-line. When this complete dermatome hypalgesia is present, the ankle jerk usually is absent. Lesser degrees of compression of the first sacral nerve root may show the dermatome hypalgesia in only the foot and leg, with the ankle jerk only reduced or varying with use of the leg.

Herniation of the fourth lumbar disk, with compression of the fifth lumbar root, is difficult to diagnose because there is no reflex loss and the sensory changes are not easily found. The characteristic hypalgesia involves the dorsum of the foot including the three middle toes, the anterolateral leg, lateral knee and thigh, curving around the buttock to the spine at the lumbosacral junction. In addition, there is a wedge-shaped area on the sole, from the three middle toes, over the lateral heel, to the Achilles tendon.

Compression of the fourth lumbar nerve root is less common. The dermatome includes the great toe and medial aspect of the foot, the anteromesial aspect of the leg, the patella, and anterolateral aspect of the thigh.

The other dermatomes in this region have not been well established.

In the author's series of 185 cases, first sacral dermatome hypalgesia was found in 116 and the site of the lesion was verified operatively in 64; fifth lumbar dermatome hypalgesia was observed in 47 cases and the site of the lesion was verified in 22. The corresponding figures for compression of the fourth lumbar nerve root were 19 and 11.

Charts are presented defining the areas of sensory nerve distribution in the lower extremities, and the clinical and surgical aspects of low back pain are discussed.

JOHN B. McANENY, M.D.

**Observations on the Regeneration of the Semilunar Cartilages in Man.** I. S. Smillie. *Brit. J. Surg.* 31: 398-401, April 1944.

Extirpation of a meniscus in animals is invariably followed by replacement by a new structure which resembles the normal cartilage in shape and appearance but is composed entirely of fibrous tissue. There are seven recorded cases of proved regeneration of a meniscus in man. In a series of 600 meniscectomies performed during the past three years, 14 patients were subjected to a second operation because of recurrence of symptoms. The following observations are based on these cases.

When the entire meniscus is excised, a new one grows in from the parietal synovial membrane, having much the same form and general appearance as the normal structure. A regenerated meniscus is recognized by its dense attachment to the capsule and by the fact that it is thinner and narrower than the normal. It is composed almost entirely of fibrous tissue.

In those cases in which only the anterior portion of the meniscus is removed, the excised portion is replaced by fibrous tissue. The junction of the regenerated horn with the original posterior horn and the difference in color and width are clearly demonstrated in the author's illustrations. These observations point to the advantages of total over partial meniscectomy. "The most perfect replica possible follows total meniscectomy."

Five cases are reported in which a regenerated meniscus had been torn. Such lesions are rare because of the density of attachment of the regenerated tissue to the capsule and the consequent reduction in mobility. In 3 cases the anterior cruciate ligament was found to be divided and in the remaining 2 cases the anterior cruciate ligament, the collateral ligaments, and the capsule were extremely lax. It is significant that in all 5 cases lesions of structures concerned with maintaining the stability of the knee joint were demonstrated.

MAX CLIMAN, M.D.

**Blastomycosis of the Skeletal System: Summary of 67 Recorded Cases and a Case Report.** Paul C. Colonna and Thomas Gucker, 3d. *J. Bone & Joint Surg.* 26: 322-328, April 1944.

This article reviews the reported cases of blastomycosis of bone and adds another to the literature. Roentgenographically the bone changes suggest an ordinary osteomyelitis. No characteristic feature is presented. The condition is usually fatal, with a recorded mortality rate of about 89 per cent. Iodides and sulfadiazine did not seem to control the disease.

JOHN B. McANENY, M.D.

**Pyogenic Coxitis: I. End-Results and Considerations of Diagnosis and Treatment.** Paul H. Harmon and Carroll O. Adams. *Surg., Gynec. & Obst.* 78: 371-390, April 1944.

The aim of the authors is the determination of those factors which lead to best functional results following suppurative in the hip joint. A study was made of the end-results of suppurative in 147 hips in 132 patients of all ages.



Cases were divided into three age groups: (a) below four years, (b) four to twelve years, (c) above twelve years. The modification of the architecture of bone about the hip by infection, which in turn is the key to hip stability, is the most important factor in determining the final result. Variations are described in each age group, but in general those from four to twelve years showed the poorest results. The amount of bone remaining in the quiescent stage is influenced by the extent of the original embolic infection and the type of treatment employed, especially its efficiency in preventing dislocation, pressure within the joint, and further loss of bone by pressure and pathological fracture.

Early diagnosis is desirable. Aspiration of the hip joint with or without arthrotomy is the only method of establishing this in doubtful cases and is confirmatory in typical cases. Diagnosis by aspiration is often possible long before roentgenograms show a bony focus. On the other hand, by the second or third day of the acute illness there may be roentgen signs of dislocation due to the accumulation of suppurative products within the joint capsule.

Following aspiration and/or arthrotomy, traction is usually preferred to plaster. Traction tends to reduce dislocation when present, prevents surface erosion of the bony cortex or pathological fracture, and allows fibrous tissue to fill in any defects in the articular cartilage. The location of the initial lesion has prognostic significance. If it is in the neck of the femur, necrosis of all or part of the femoral head, with or without pathological fracture of the neck, is seen. Initial lesions in the femoral head were not observed. When the osteomyelitic focus is in the bones of the pelvis, the joint is more often spared.

Sulfonamides are useful. It is pointed out, however, that the essential osseous picture following suppuration is not changed but modified in the direction of lessened virulence. The surgeon can await the evidence of localization of the osteomyelitis in roentgenograms with less danger of joint and other complications when these drugs are employed.

The authors conclude that a relatively benign course of the disease is seen (a) in the very young and in persons beyond the age of fifteen, in whom bone involvement is often restricted in extent; (b) in other age groups where the bone lesion is small or non-existent; (c) in cases where early arthrotomy and prolonged and continuous traction are employed. The greatest disability appeared in cases following massive osteomyelitis. A movable hip stabilized in the primary acetabulum is more desirable than an ankylosed hip unless such motion is accompanied by pain. Loss of leg length is chiefly due to dislocation of the hip and bone loss.

Roentgenograms with accompanying case histories illustrate this report. STUART P. BARDEN, M.D.

**Pyogenic Coxitis: II. Indications for Surgical Treatment in Residual and Chronic Stages and End-Results of Reconstruction in 53 Patients.** Paul H. Harmon and Carroll O. Adams. *Surg., Gynec. & Obst.* 78: 497-508, May 1944.

In this paper the authors review the results of 83 reconstructive surgical operations for residual deformities or other chronic disorders of the hip, performed in 53 of the patients in their original series (see preceding abstract). Just when such procedures should be undertaken depends directly upon the patient's age at the

onset of the acute phase and the rapidity and effectiveness of control of the initial suppuration.

Measures to eliminate discharge from draining sinuses that promise not to clear otherwise can be undertaken in a few months after subsidence of the acute phase. The first step is the discovery of the cause of the continued drainage, and for this purpose roentgenography and injection of the sinus tracts with opaque materials are the most satisfactory procedures. The most common causes are sequestra, epithelialized sinuses, and chronic bone abscesses. For their correction the authors employed sequestrotomy for all or a portion of the femoral head, radical excision of the ilium, or hip joint disarticulation. These procedures carried out on a single damaged hip gave satisfactory results in 80 per cent (average) of the 20 cases in which they were applied.

Malposition of the fused hip should not receive surgical attention until after the approximate age of twelve or thirteen years, unless the malposition is grossly exaggerated, and in this event later correction will usually be required. In general, surgical stabilization of slightly movable hips and positional correction in those already naturally ankylosed by the acute disease yield better permanent results in terms of painless extremities serviceable in weight-bearing than arthroplastic attempts to secure a movable hip.

For the equalization of leg length, the bone shortening operations were found to give uniformly satisfactory results. Epiphyseal arrest procedures were not in general successful. This is attributed to the fact that they were performed chiefly on adolescent girls, at a time when it was not appreciated that longitudinal growth of the long bones in girls often ceases at eleven to thirteen years of age. While better results might be expected in a properly selected series, the authors consider the bone-shortening operation the procedure of choice.

The least satisfactory end-results were those in patients with bilateral deformities from acute involvement of both hips. Since these patients were seen before the modern era of arthroplasty, however, little in the way of treatment was attempted.

Like the earlier paper, this is illustrated by good roentgenograms.

**Cause of Discrepancy in Length of the Limbs Following Tuberculosis of the Hip in Children. Arrest of Growth from Premature Central Closure of the Epiphyseal Cartilages about the Knee.** Gerald G. Gill. *J. Bone & Joint Surg.* 26: 272-281, April 1944.

The retardation of bone growth in the lower extremity following tuberculosis of the hip is shown to be due to early closure of the epiphysis in the lower femur or upper tibia or both. This is best seen in roentgenograms of the knee, where a bony lock between the epiphysis and diaphysis occurs at or near the center of the cartilage plate. Multiple striations are seen to cross this region. In the lower femur the epiphyseal line forms an inverted V and the bicondylar notch is deeper than on the normal side. In the upper tibia the line of epiphyseal union is flattened or forms an upright V; the tibial spine is underdeveloped and the articular surface sometimes becomes saucer-shaped. These changes persist throughout life but may be modified by added arthritic changes. The fibula may continue to grow, becoming longer than the tibia and even bowing.

There is no evidence that the tuberculous process is the cause of premature epiphyseal closure. This is believed to be due to immobilization followed by decalcification of the bone, with softening of the cancellous portion, which may become almost fluid. With the application of pressure the membrane ruptures and union follows between the epiphysis and diaphysis.

The extremities should be measured at frequent intervals and changes should be sought in the roentgenograms of the bones, so that the opportune time may be chosen for institution of corrective measures.

Six case reports are presented, and several roentgenograms are reproduced to demonstrate details.

JOHN B. MCANENY, M.D.

**Periarthritis of the Shoulder Joint.** Arthur Steindler. *J. Iowa M. Soc.* 34: 134-138, April 1944.

Periarthritis of the shoulder joint most frequently involves the structures of the floor of the bursa. Tears of the tendon are followed by degenerative changes, which in turn may be succeeded by the deposition of lime salts. These calcareous deposits may perforate into the bursa itself, forming visible accumulations. Most often they come from the supraspinatus tendon, but they may also arise from the infraspinatus, teres minor, or even the subscapularis tendon. Tears may be either complete or incomplete. A "frozen shoulder" may result from an extensive tendinitis of the entire cuff with subsequent adhesions, or a primary villous bursitis may develop.

Radiographically there may be osteo-arthritis changes in the greater tuberosity, with the formation of subchondral cysts and eburnation at the points of insertion of the tendons.

Clinically the process may be classified as a complete rupture of the tendon, incomplete rupture of the supraspinatus muscle, or bursitis.

Conservative treatment, comprising fixation in a splint or cast, physiotherapy, or roentgen therapy, is used in (a) acute cases, (b) spasmodic cases, (c) cases with solitary adhesions, and (d) the infrequent case of spontaneously disappearing deposits. There are three additional measures applicable with advantage in the early stages. These are novocaine infiltration, needle lacerations of the calcified tendon, and injection or irrigation of the bursa.

Cases requiring operative treatment are: (a) adhesive bursitis with broad adhesions, (b) chronic non-adhesive bursitis with thickening of the surface of the bursa, (c) tendinous tears that do not undergo spontaneous repair. In cases of supraspinatus tears with or without calcified deposits, the author reports good operative results in 80 per cent. Excision of the bursa produced good results in only 50 per cent of those thus treated. In neither instance is the total number of cases given.

E. W. GODFREY, M.D.

**Fractures of the Carpal Scaphoid Bone in Industry and in the Military Service.** M. G. Henry. *Arch. Surg.* 48: 278-283, April 1944. Also in *Mil. Surgeon* 95: 199-205, September 1944.

Fracture of the carpal scaphoid is readily missed. It leads to pain and disability, offers a perplexing problem to the physician and is of industrial and military significance. In a five-year survey of an industry of a hazardous nature only 12 cases were diagnosed by the author, yet in four months at a large naval embark-

ation and receiving base he found 22 cases. All of the latter group were the result of falling on the hand during rigorous exercise maneuvers.

All wrist sprains not showing progress in a week should be examined radiographically, with the hand in extreme ulnar deviation at the wrist joint. Complete fracture through the middle to inner third with any degree of displacement should be treated by excision, as the damage to the circulation usually prevents union, and a better functional result is thus secured. For crack fractures immobilization, diathermy, whirlpool baths, and passive and active motion are indicated. Comminuted fractures of the outer third should be treated by excision of the fragments only, the main piece of bone being left. Dislocations and crushing injuries require complete removal of the scaphoid. In the five-year industrial survey, non-union was observed in 25 per cent of the cases; in the larger group of military cases the percentage was 32. Early excision led to excellent functional results.

[While the technic favored by the author for roentgen demonstration of the scaphoid is good, there are others which should not be neglected. The abstractor's experience is that crack fractures will not infrequently be demonstrated on only one of a number of technically good views of the scaphoid, and when there is a question several positions rather than any one would seem to be indicated.]

LEWIS G. JACOBS, M.D.

**Fracture-Dislocation of the Base of the Fifth Metacarpal Bone.** Bryan C. Murless. *Brit. J. Surg.* 31: 402-404, April 1944.

Dislocations of the 5th metacarpal without associated dislocations of the other bones of the hand are rare. A case is described in which there was little clinical evidence to suggest the nature of the injury. Radiographic examination showed the base of the 5th metacarpal displaced forward and toward the radial side. A small detached fragment of bone was noted lying to the medial side of the wrist. This was demonstrable only in the anteroposterior view taken in supination.

Seven similar cases are reported from the literature. The detached fragment was demonstrable only in those cases examined roentgenographically with the wrist in supination. The fragment is most likely detached from the base of the 5th metacarpal. If manipulation is undertaken immediately or within a reasonable time, the dislocation may be successfully reduced and maintained in position. In the author's case reduction of the dislocation was successfully carried out six hours after the injury.

MAX CLIMAN, M.D.

**March Fractures of the Tibia and Femur.** Samuel E. Proctor, Thomas A. Campbell, and Martin Dobelle. *Surg., Gynec. & Obst.* 78: 415-418, April 1944.

A series of 1 femoral and 7 tibial march fractures is reported, including an example of bilateral march fracture of the tibiae, the fourth to be reported.

These cases were seen at an army station hospital. In cases involving the tibia the presenting symptom was pain in the upper tibia, coming on during strenuous exercise and followed by lameness. The only abnormal laboratory findings of note were the consistently lowered serum calcium levels and slightly elevated serum phosphorus levels.

Calcium therapy and immobilization casts were not used. Treatment consisted in physiotherapy and cessation of all strenuous exercise.

The roentgen appearance of these lesions depends upon the time of examination. The author describes four stages and illustrates these as they occur in the tibia:

*Stage 1:* Within one week of the fracture a fine horizontal fracture line is seen about 10 cm. from the proximal end of the tibia.

*Stage 2:* In the second week after fracture a small amount of callus is seen on the posteromedial aspect of the cortical fracture site.

*Stage 3:* In the third week a band of bone condensation is seen at the fracture site with a zone of bone absorption at the immediate fracture line.

*Stage 4:* After the third week the cortical callus and the bone condensation increase, with disappearance of the fracture line. Callus begins to disappear after the twelfth week.

It is emphasized that, after Stage 1, march fractures must be differentiated from Garré's sclerosing osteomyelitis, osteogenic sarcoma, Ewing's tumor, and syphilis and tuberculosis of the bone. Stress is placed on the value of the serial examination and the recognition of the stage of the fracture. It is also pointed out that more bilateral march fractures would probably be found with routine examination of the contralateral extremity.

J. FRANCIS MAHONEY, M.D.

**March Fractures of the Femur.** Hira E. Branch. *J. Bone & Joint Surg.* 26: 387-391, April 1944.

The various names given to the march fracture are enumerated and the clinical sequence of events is reviewed. This fracture occurs most frequently in the second and third metatarsals, and less frequently in the tibia, fibula, calcaneus, femur, pelvis, humerus, patella, and vertebral arch.

Three case reports with roentgenograms of march fractures of the femoral shaft and femoral neck are presented.

JOHN B. MCANENY, M.D.

**The Solitary Bone Cyst. Report of a Case of Twenty Years' Duration.** Samuel Kleinberg. *J. Bone & Joint Surg.* 26: 337-343, April 1944.

This is a report of a solitary bone cyst in the upper right femur, proved to be of twenty years' duration. It establishes the benign character of the lesion, its prolonged course, and the absence of spontaneous healing.

The bone was opened and thoroughly curetted, and the cavity was filled with bone chips, resulting in complete obliteration of the defect.

JOHN B. MCANENY, M.D.

**Erythroblastic Anemia of Cooley (Familial Erythroblastic Anemia) in an Indian Boy.** R. G. Dhayagude. *Am. J. Dis. Child.* 67: 290-293, April 1944.

Although it has been generally held that Cooley's anemia is to be found only in children of Mediterranean stock, a number of instances have been reported in Asiatics.

The author's patient was a 7-year-old Brahmin boy of Bombay, who came to examination because of general debility following typhoid fever. The child's head was enlarged, and the facies was mongoloid in type, with muddy discoloration of the skin, prominent malar bones, and well developed epicanthic folds. The sternum was pushed forward, with Harrison's sulcus on either side, but there was no osteochondral beading. A soft systolic bruit was audible over the cardiac area, especially in the region of the apex, which was in the

mid-clavicular line in the 7th interspace. The abdomen was distinctly protuberant. The liver and spleen were enlarged.

Examination of the blood showed a hypochromic anemia. The red cell count was 2,200,000, with hemoglobin averaging 30 per cent (Tallqvist) and a color index between 0.7 and 0.8. The leukocyte count ranged from 17,000 to 36,000 per cu. mm. The red cells showed anisocytosis and poikilocytosis with polychromatophilia. Bilirubin was present as indicated by the van den Bergh indirect test. An excess of urobilin was found in the urine, and the icteric index was 7. Gastric analysis showed no free hydrochloric acid in the fasting sample but a small amount was present in the half and three-quarter hour samples; occult blood and bile were also demonstrated.

Roentgenograms of the skull showed the typical picture of porous, greatly thickened bones forming the vault, with a radiate appearance. The cancellous portions of the bones of the hands and feet were spongy, with a peculiar trabeculation.

A brief review of the literature, with references, is included.

LESTER M. J. FREEDMAN, M.D.

## THE GENITO-URINARY TRACT

**Present Status of Intravenous and Retrograde Pyelography.** Walter E. Hatch. *Minnesota Med.* 27: 281-284, April 1944.

The author begins with one statement which, in the opinion of this reviewer, cannot be too highly praised: "It is beyond my comprehension, how, at times, some of us will accept a very poor and entirely unsatisfactory intravenous pyelogram and will proceed with some major treatment when, if the method had been retrograde, one would have considered the film as entirely worthless."

As contraindicating to intravenous urography the following conditions are cited: severe renal insufficiency, cardiovascular disease, impaired hepatic function, active tuberculosis, hyperthyroidism, iodine idiosyncrasy, and hyperpyrexia. The suggestion is made that idiosyncrasy be determined by the injection of 0.05 c.c. of the drug intradermally.

The "clearance test" consists in giving the dye, collecting all the urine secreted in the next thirty minutes, and measuring the iodine content. Normal subjects are supposed to excrete something like 45 per cent of the iodine during this interval.

The author wisely stresses the fact that a kidney which shows no shadow with intravenous urography, even in thirty minutes, may prove to be quite normal when the retrograde method is used.

PERCY J. DELANO, M.D.

**Classification of Renal Neoplasms: A Clinical and Pathological Study Based on 199 Cases.** M. M. Melnick. *J. Urol.* 51: 333-385, April 1944.

The author reviews the evidence for and against the Grawitz theory of adrenal-rest origin of renal tumors. He concludes that true hypernephromas are rare and constitute a very small percentage of cases and that most parenchymal neoplasms arise from epithelial constituents of the glomeruli or tubules. One hundred and ninety-nine cases are reviewed and classified under three general headings, according to origin in pelvis, parenchyma, or capsule. The analysis is based on microscopic, gross, and pyelographic appearance along

with clinical features and end-results. The tumors are classified as follows:

- (A) Pelvic tumors (15%)
- (1) Papillary (17 cases). Benign in younger age groups. Older group showed infiltrating type. Their course suggests that they are a manifestation of a general vulnerability of the urinary epithelium to neoplasms.
  - (2) Non-papillary (13 cases). Squamous-cell tumors with epithelial pearl formation. Occur in older people.
- (B) Parenchymal tumors (80-85%)
- (1) Clear-cell carcinoma (80 cases). Arises from renal tubule system. The cells resemble the epithelium of the renal tubules. Early the tumors tend to slow and relatively orderly growth with encapsulation. Later there are necrosis, hemorrhage, and breaking through the capsule barrier, with extension and metastases. Of the 80 cases of clear-cell carcinoma, 36 were uncomplicated, 37 showed the secondary changes noted above, and 7 showed the tubular character intact.
  - (2) Granular-cell carcinoma (18 cases). Cells small and granular. Probably arises from epithelium in the region of the glomeruli. The tumors lack a capsule and tend to diffuse invasion of the kidney.
  - (3) True hypernephroma (3 cases). Clinically these resembled the clear-cell carcinomas, but the microscopic appearance was similar to adrenal cortex.
  - (4) Neoplasm in cyst of kidney (14 cases). Tumors within large solitary cysts, usually papillary, relatively benign, and often associated with other anomalies of the urinary tract. When they break through the capsule, they may resemble granular-cell carcinomas.
  - (5) Multiple adenomas, cystadenomas or carcinoma in fibrotic kidneys (10 cases). Tendency to be bilateral, like polycystic disease. Associated with fibrotic lesions of the kidneys. Removal of one kidney may result in renal insufficiency.
  - (6) Mixed tumors in adults (6 cases). Most malignant of all the renal neoplasms. Usually carcinomatous centrally and sarcomatous peripherally. All patients died within a short time.
  - (7) Mixed tumors of infants—Wilms' tumors (9 cases). Rapid growth, with both local invasion and metastases. Carcinosarcomas apparently of dual origin.
  - (8) Miscellaneous neoplasms of renal parenchyma (3 cases). A solitary fibroma, a liposarcoma, and a hemangioblastoma.
- (C) Tumors of renal capsule (rare).
- Two cases: a fibrosarcoma and a fibroliposarcoma.

Twenty-four cases were included in the study, in which operation was not performed, chiefly because of inoperability.

In the radiographic study special attention should be directed to the size, shape, location, and density of the renal shadow in the flat film. An increase in size, especially if asymmetrical or a bulge of the convex border or of one pole, is noteworthy. A cyst containing fluid

may show decreased density, while a tumor may produce increased density. Displacements may be due to tumors or cysts of either pole. Calcium density may outline the wall of a cyst while scattered dots of calcium suggest lime deposits in old hemorrhage of tumor or cyst.

The pelvic tumors, especially of the papillary type, produce a characteristic filling defect in the pyelogram. Blood clots and intracalicular non-opaque calculi are a differential problem. In the non-papillary type, calculi confuse the picture. In parenchymal neoplasms the textbook picture of elongated, narrowed calices occurs in uncomplicated clear-cell carcinoma and in tumor in solitary cyst. Pinching off or obliteration of calices with distortion and constriction of the pelvis occurs in advanced clear-cell carcinoma and in granular-cell and mixed tumors.

The advent of metastases is a matter of lymphatic or vascular penetration by tumor cells. The lungs and bones are the most frequent sites and the most readily discernible. Any organ may be affected. The microscopic appearance of metastases or recurrences may differ from that of the original lesion. At times the symptoms produced by the metastasis may be the chief complaint, and the author suggests routine radiographic study of the kidneys in all cases of brain tumor.

Renal neoplasms are more common in males by a ratio of 2.5 to 1. They occur most frequently between the ages of forty and sixty. They are equally frequent on the two sides, but more inoperable tumors are found on the left.

Painless hematuria, pain referable to the renal area, and a mass are the usual symptoms, occurring in this order. A reversal in the order of the appearance of the symptoms or the presence of constitutional signs, such as fever, leukocytosis, and loss of weight, make the outlook poor. The gravity of the prognosis is directly proportional to the size of the tumor and the duration of the symptoms. The prognosis in the different types of parenchymal tumors is progressively worse from the uncomplicated clear-cell carcinomas, to the advanced clear-cell carcinomas, to the granular-cell carcinomas, to the mixed-cell tumors. Grading is not feasible except for tumors arising in the pelvis.

J. L. BOYER, M.D.

**Tuberculoma of Ectopic Kidney.** Mordecai Nachman. *J. Urol.* 51: 395-396, April 1944.

The author presents what he believes to be the first recorded case of a tuberculoma of an ectopic kidney.

The patient was a 41-year-old white woman who had no complaints referable to the urinary tract and whose only symptom was a mass in the left lower abdominal quadrant, of two months' duration. Routine laboratory studies were negative. There was no evidence of disease in the chest, and the bladder appeared normal cystoscopically. Phenolsulfonphthalein excretion was delayed and diminished from the left kidney. Retrograde pyelography revealed a large filling defect in the left renal pelvis, with distortion of the calices. The pre-operative diagnosis was malignant tumor of a left ectopic kidney.

At operation the enlarged left kidney was removed. The cortex was thin, and within the pelvis, extending into the cortex at one point, was a nodular mass measuring 9 cm. in its greatest diameter, with multiple small areas of caseation scattered through it. This mass



proved to be a tuberculoma. The ureter showed inflammatory change but no tubercles.

J. FRANCIS MAHONEY, M.D.

**Diverticulum of the Female Urethra.** John G. Menville and Joseph D. Mitchell, Jr. *J. Urol.* 51: 411-423, April 1944.

Menville and Mitchell review the 69 previously reported cases of diverticulum of the female urethra and report 11 cases of their own. Many causes are suggested for these, the most common in the opinion of the authors being trauma. Infection is the most frequent complication, occurring in almost every case. It is this that causes the majority of symptoms. The typical history is exemplified by intermittent attacks of dysuria, frequency, partial incontinence, discharge of pus or a cloudy urine from the urethra, and urethral pain. The pathognomonic sign is a fluctuating mass which empties on pressure.

Injection of the diverticulum through a catheter in the neck of the sac or urethrography will enable one to visualize the diverticulum roentgenographically.

The authors feel that the treatment of choice is excision of the sac.

The roentgenograms used to illustrate the paper show the lesions clearly. JOHN O. LAFFERTY, M.D.

**Importance of the Roentgen Examination in the Diagnosis of Adenoma of the Prostate.** Athayde Pereira. *Am. J. Roentgenol.* 51: 600-613, May 1944.

The substrate of adenoma of the prostatic urethra is an intense cellular hyperplasia of the submucous or suburethral glands, sometimes called Lendorf's accessory periurethral glands. These are of endodermal origin. The clinical forms of adenoma of the prostate are characterized by the solitary or combined growth of these cell groups. On the other hand, the prostatic glands properly so-called (of mesodermal origin) when affected by tumoral new growth (adenoma) may cause enlargement of the organ with the same clinical manifestations as total adenoma of the submucous glands. The direction of the growth from either source may be vesical, subvesical, or perineal. At present the development of adenoma of the prostatic glands, properly speaking, is thought to have the same origin as that of tumors in general, while adenoma of the suburethral or submucous glands is thought to be due to a hormonal disequilibrium due to change of life.

The technic of urethrocystography consists in first filling the bladder with the contrast medium for the purpose of showing its entire outline and then filling the whole of the urethra (15 to 20 c.c. of contrast medium). A roentgenogram is made exactly during the terminal part of the urethral injection. Films are made in lateral oblique and anteroposterior positions. The contrast medium used is a suspension of "luxobarium" (which has a barium sulfate base) in the proportion of 60 gm. of powder to 100 c.c. of boiling water. The points to be considered in the roentgen diagnosis are: (a) the characteristics of the bulbar filling; (b) the form and relations of the membranous urethra to the adenoma; (c) the elongation, deformities, dilatations, and angulations of the prostatic urethra; (d) the arrangement of the "internal sphincter" in relation to the bladder cavity; (e) the configuration of the elevations on the basal plane of the bladder; (f) the perfection, the clearness, and the deformities of the outline of the bladder.

In solitary middle lobe enlargement, the "internal sphincter" is directed forward, there is angulation of the prostatic urethra, and the nodule protrudes into the bladder back of the "sphincter." If there are accompanying lateral lobes with a subvesical or intravesical growth, there is a varying degree of elongation of the prostatic urethra. In the ventral lobe (rarely seen) the "sphincter" is turned upward, the tumor nodule protruding into the base in front of the "sphincter." In total adenoma the lateral lobes in the profile roentgenogram project more or less into the base with equal or unequal growth of the two sides, the "sphincter" is turned upward, the image of the urethra is not elongated in the beginning but becomes increasingly elongated, broadened, and deformed as the adenoma nodules increase in size.

This method of examination is contraindicated (a) following recent trauma from instrumental examination; (b) in patients with acute or recent gonorrhea; (c) in the course of subacute adnexitis; (d) in the course of treatment of abscess of the prostate. Among other advantages of this examination, it shows the relation between an adenoma with subvesical growth and the parts of the membranous and bulbar urethra, giving a warning of the dangers of instrumentation, and it permits of differential diagnosis between adenoma of the prostate and dyssectasias of the neck.

CLARENCE E. WEAVER, M.D.

## TECHNIC AND APPARATUS

**Design for an X-Ray Department at an Advance Base Hospital.** John W. Olds. *U. S. Nav. M. Bull.* 42: 935-947, April 1944.

The author describes in detail the adaptation of a 20- by 48-foot steel hut for use as a radiographic department at an advance base hospital. A central corridor extends the length of the building. The front section is utilized as an office and film-reading room on one side and as a waiting room on the other. Films on inactive cases are filed in discarded 14 × 17-in. film boxes in built-in compartments beneath the benches in the waiting room. The carrying case for the portable x-ray unit is similarly stored.

The central portion of the hut is given over to two general x-ray rooms. The partitioning for the corridor extends only along one side, and a combined fluoroscopic and radiographic unit is set up in the spaces provided. Double doors 8 feet wide and 6 1/2 feet high open into the corridor, and when these are swung back, the effect is that of a single large room. A mobile unit is operated in the adjacent area.

The space at the rear of the hut serves as a film-processing and storage room.

The author advises that grids be kept in the original hardwood shipping case and a plywood panel be inserted to maintain constant pressure to prevent warping in regions with high humidity. Radiographic equipment should preferably be connected to a generator ahead of any other connections which draw a significant amount of current, in order to produce stability of voltage.

E. W. GODFREY, M.D.

**The Magazine Cassette X-Ray Unit.** H. R. Edwards and Aaron Siegel. *Am. Rev. Tuberc.* 49: 366-373, April 1944.

A description is given of a magazine cassette unit for



rapid chest radiography in mass surveys. The unit uses sensitized paper in rolls, each of which provides fifty 14 × 17-in. films. Mechanically, the unit can be operated at the rate of 100 cases per hour; in general, the speed depends upon the staff available. The authors favor paper film over microfluorograms and over the corresponding 14 × 17-in. cellulose base films because of the saving in cost. The unit is provided by the manufacturer of paper film on a rental basis. It can be used with standard x-ray equipment and darkroom facilities and can be employed effectively with equipment of low capacity.

L. W. PAUL, M.D.

**Instantaneous Stereography.** G. L. Rogers. *Brit. J. Radiol.* 17: 122-125, April 1944.

Instantaneous stereography is a method of making stereograms by means of two tubes on one plate through a grid. There is a definite relationship between the distance from the grid to the film, the distance from the focal spot to the plate, the distance between the targets, and the number of lines in the grid. The method is of particular use for studies of the heart and viscera, for arteriograms and venograms, and for localization of radium needle implants.

SYDNEY J. HAWLEY, M.D.

## RADIOTHERAPY

### NEOPLASMS

**Meningioma of Thirty Years' Duration: Report of a Case.** R. B. Cloward and R. D. Kepner. *Arch. Neurol. & Psychiat.* 50: 327-334, September 1943.

The case of a patient with a recurrent intracranial meningioma of the right frontal lobe of thirty years' duration is presented. This, the authors believe, is the "oldest" meningioma yet recorded.

The slow rate of growth of this lesion is explained by several factors. The original tumor was probably a meningioma *en plaque* arising from the sphenoid bone. Cushing's statistics show that such tumors grow very slowly and have longer clinical histories than any other intracranial meningiomata. Furthermore, the lesion was located far forward in the frontal lobe and remained symptomless for a long time. The skull flap had been completely removed at the time of the first operation, and for this reason the tumor had plenty of room to expand without producing a significant increase in intracranial pressure.

Roentgen therapy was administered following the initial operation, and the authors suggest that the roentgen rays, producing sclerosis and fibrosis of the dura, blood vessels, and bone, may have increased the resistance of these tissues to the invading neoplasm and thus further retarded tumor growth.

DEPARTMENT OF ROENTGENOLOGY  
UNIVERSITY OF MICHIGAN (J. H.)

**Modern Trends in the Treatment of Carcinoma of the Breast.** Oliver Chance. *Irish. J. M. Sc.*, April 1944, pp. 105-110.

A statistical study was made of 104 patients referred to St. Anne's Hospital, Dublin, for radiation therapy of cancer of the breast recurring after operation alone. Radical mastectomy had been performed in 67, and simple mastectomy or local excision of the mass in 37 instances. In the radical operative group, local metastases occurred in 39 per cent, metastases in the axillary or supraclavicular nodes in 47.5 per cent, distant metastases in 13 per cent. For the simple operative group, the figures were: local metastases, 65 per cent; lymph node metastases 29.5 per cent; distant metastases 6 per cent. Following irradiation, the group with local metastases had a three-year survival rate of 35 per cent and a five-year survival rate of only 8 per cent; the cases with lymph node and distant metastases had a three-year survival rate of 38 per cent and a five-year survival rate of 33 per cent.

The author concludes that radical mastectomy gives

a better chance of survival than local amputation or excision of the tumor. Noting that recurrences were apparently sterilized in one out of three cases, he suggests that Keynes' method of simple mastectomy followed by radium application to the chest wall and lymph node areas should be further investigated.

The author's general treatment plan calls for radical mastectomy when possible. No postoperative irradiation is given when the mass is local and freely movable unless microscopic section shows node involvement, in which case only the axillary and supraclavicular areas should be heavily irradiated. Preoperative irradiation is given in operable cases only when aspiration biopsy shows considerable anaplasia of the tumor. Irradiation may render an inoperable carcinoma operable, and in such cases postoperative irradiation may also be given. When the primary lesion is operable but the nodes are not, amputation of the breast and irradiation of the node-bearing areas are indicated. Irradiation of the chest wall is reserved for cases showing metastatic disease; in such cases radium is preferred to x-rays. Bone metastases show the most spectacular response to irradiation.

LESTER M. J. FREEDMAN, M.D.

**Treatment of Carcinoma of the Lung: Symposium.** J. L. Livingstone, R. C. Brock, Ffrangcon Roberts, J. L. Dobbie, and W. L. Harnett. *Brit. J. Radiol.* 17: 101-109, April 1944.

Livingstone, opening this symposium on bronchial carcinoma, states that the disease is invariably fatal, though a patient may survive a long time without treatment. One woman is known to have lived four and a half years, during which time she gained 18 pounds.

At the present time the only curative treatment is surgical removal. This is possible in 10 to 20 per cent of cases, but earlier diagnosis will raise the percentage. Bronchoscopy and biopsy are essential when possible. Small peripheral tumors are the most difficult to diagnose. They are hard to differentiate from tuberculosis, lung abscess, metastatic growths, and hydatid and simple cysts.

Brock, while granting x-ray therapy a place in the treatment of bronchial carcinoma, considers that the only method which affords hope of a cure is surgery. Lobectomy is the operation of choice. With diagnosis in its present state of accuracy, some 10 per cent of the cases are operable—about half those now coming to operation. The mortality from lobectomy is 28 per cent, but with a selection of reasonably favorable cases this can be reduced to 15 per cent. In Brock's own

series of 32 cases surgically treated, there were 9 operative deaths; 8 patients died of recurrence within two and a half years. Of the 15 patients surviving, all had a good functional result. [In 5 of these, however, the interval after operation was less than a year, and in no instance did it reach five years.] The pleural space became infected in 2 cases.

*Roberts* believes that irradiation has much to offer the sufferer from bronchial cancer. Even in advanced cases there may be substantial relief of symptoms, and in many instances there is a material prolongation of life. In administering treatment, many small fields should be used. Twenty-four are advocated by this writer. Each field receives 1,200 r, giving a total skin dose of 28,800 r. The depth dose cannot be accurately determined. One patient was living and well after six years.

*Dobbie* reports a series of 170 cases of bronchial carcinoma treated by roentgen rays during 1935 to 1942; 57 per cent had secondary spread when first seen and 27 per cent had remote metastases. Tomography is regarded as a great aid in the diagnosis. Positive biopsies were obtained by bronchoscopy in only 34 of this series. Palliative treatment was given to 111 patients; 26 per cent lived more than six months, and 40 per cent had some relief of symptoms. Fifty-nine patients were treated radically by irradiation. Of these, 11 are alive, 8 for a year or more.

*Harnett* states that of 15,200 cases of cancer registered in the seventeen months prior to September 1939, 1,023 were primary bronchial carcinoma. The ratio of males to females was 4.6 to 1. The mean age of the males was 55.9 and of the females 57.7 years. Bronchial carcinoma accounted for 11.5 per cent of all cancer cases in males and 2.3 per cent in females. Fifty-nine per cent of the cases were so far advanced that treatment was purely palliative. Thoracic exploration was undertaken in 5 per cent, but only 1.5 per cent were suitable for pneumonectomy. Twenty per cent received deep x-ray therapy; 1.4 per cent were treated by intrabronchial radon, and 2.3 per cent by interstitial radon. The average time between the first symptom noticed by the patient and death was  $10.2 \pm 0.3$  months. SYDNEY J. HAWLEY, M.D.

**Carcinoma of the Cervix, End Results.** Charles A. Behney and John Y. Howson. *Am. J. Obst. & Gynec.* 47: 506-512, April 1944.

In 1931, Behney (*Am. J. Roentgenol.* 27: 877, 1932) made a study of the duration of life of 437 women with cervical cancer who had been seen in the Radiologic Department of the Philadelphia General Hospital and followed until death, in an attempt to determine the value of high-voltage therapy. In the ensuing years (1931-1942), 579 additional patients have died of this disease. The present study is based on observations in this latter group, which are compared with the findings in the earlier series.

From 1928 to 1931 all patients whose general condition permitted were treated with high-voltage therapy regardless of the extent of the disease. The usual dosage was 1,600 to 1,800 r (in air) to each of four to six fields,  $15 \times 20$  cm., depending upon the size of the patient. In the late stages, this was the only form of treatment. Lesions in the first, second, and third stages received, in addition, radon in the cervical and uterine canal and radon against the vaginal portion of

the growth. The intracervico-uterine dosage ranged from 2,000 to 3,000 mc. hr., depending on the depth of the cervical canal. The vaginal application of radon was made in three sittings; 1,000 mc. hr. with a filtration of 0.5 mm. silver and 3.0 mm. lead and rubber (approximately equivalent to 2.0 mm. platinum) at a distance of 1 cm., applied transversely against the cervical growth and into each vaginal fornix to provide a three-directional cross-fire, totaling 3,000 mc. hr.

After 1931, many Stage IV patients responding favorably to high-voltage roentgen therapy were subsequently treated with the standard dosage of radon in the uterine and cervical canals and against the vaginal portion of the cervix, followed six to eight weeks later by a second course of high-voltage therapy. Since 1938 an ever increasing number of patients have also received transvaginal high-voltage roentgen irradiation. In other respects the technic of treatment in the two series was identical.

The later series included 5 Stage I and 27 Stage II cases (as compared with 1 and 3, respectively, in the earlier series), 168 Stage III, 260 Stage IV, and 119 Stage V cases.

Of the patients with Stage I lesions, 1 died before treatment could be instituted, from another cause. The average duration of life for the 4 treated patients was 9.5 months as compared with 21 months for the single patient in the earlier series.

For 20 patients in Stage II receiving high-voltage x-ray therapy and radon, the average life span after admission was 17.2 months, as compared to 13.3 months for the 3 Stage II cases in the first group. In the remaining 7 cases treatment was refused or incomplete.

Of the Stage III patients, 11 were untreated and survived for an average of 4.6 months. Twelve treated by radium alone lived for an average of 9 months. Ninety-nine received the standard treatment—high-voltage roentgen therapy and radon—and lived an average of 18.8 months, an improvement of 7 months (40 per cent) over the group reported in 1931. Forty-six patients treated only with high-voltage roentgen rays, applied externally and in some cases transvaginally, lived an average of 10.8 months, an improvement of almost 4 months (50 per cent) over the comparable group in the earlier series.

Of the 260 Stage IV patients, 85 were untreated, and their average duration of life was only 1.8 months. Four patients had intravaginal applications of radon with 0.5 mm. silver and 5.0 mm. lead filtration at a distance of 1 cm. and lived an average of 8.66 months. In 10 patients receiving high-voltage therapy the tumor regressed so that the cervix was again movable, and these were subsequently treated with radon. They lived an average of 13 months. One hundred and sixty-one patients treated with external high-voltage radiation alone lived an average of 7.9 months. The duration of life in the group treated with heavily filtered radon was twice as great as for those treated by lightly filtered radon in the earlier period. Also, those receiving x-ray therapy and radon lived twice as long as those previously reported.

For Stage V cases, the average survival periods were as follows: 60 untreated, 2.4 months; 52 receiving high-voltage therapy alone, 12.4 months; 7 treated by high-voltage x-rays and subsequent radon application, 14.1 months. The only considerable difference from the earlier series was observed in those receiving only high-voltage therapy; these lived nearly twice as long

as those previously treated, probably because of more adequate dosage.

The authors believe that this study, especially when considered in conjunction with Behney's earlier report, indicates the value of high-voltage therapy in carcinoma of the cervix. The best results were obtained in those patients who, after regression of the primary lesion had been brought about by high-voltage x-ray therapy, were subsequently treated by heavily filtered radon at a distance of 1 cm.

STEPHEN N. TAGER, M.D.

**Late Bladder Injuries Following Treatment of Carcinoma of the Cervix.** David M. Farrell and George A. Hahn. *Urol. & Cutan. Rev.* 48: 165-168, April 1944.

Three types of bladder reactions following irradiation for carcinoma of the cervix are recognized: (1) a primary erythema, appearing within twenty-four hours; (2) a secondary erythema, some four weeks later; (3) a tertiary reaction, which may occur any time after a year. The primary erythema is a non-specific reaction to a local irritant. It may be symptomless or may be manifested by a mild urinary frequency. The secondary reaction is a specific one and varies from congestion to acute inflammation with fibrinous exudate. It yields promptly to local treatment. Symptoms of the tertiary reaction are hematuria, dysuria, and frequency, usually of sudden onset. The bladder shows telangiectatic areas with sloughing, ulceration, and co-existent infection. The lesions are the result of an obliterative endarteritis.

Bladder injury following radiotherapy for cervical cancer is not usually due to overdosage of radium or x-rays. A possible contributory factor is the sensitivity of the skin. Its thickness, pigmentation, and blood supply may all play a part. The size and shape of the applicators and the amount of filtration are other factors to be considered. In interstitial irradiation it is essential that most of the beta rays be removed.

The diagnosis of bladder changes can be made with certainty only by cystoscopic examination and biopsy. A common error is to mistake a radiation reaction for a metastatic cancer. This is of serious significance, since it may lead to further irradiation, producing irreparable injury in an already severely damaged organ. Treatment is directed to relief of symptoms, prevention of infection, and improvement of the patient's general condition. The prognosis is good if the patient recovers from the acute episode of bleeding.

Two cases of tertiary bladder complications of irradiation therapy of cervical cancer are presented, in one instance ten years following treatment and in the other a year and a half. In neither case was there any evidence of recurrence or extension of the original tumor.

MAURICE D. SACHS, M.D.

**Malignant Cystadenoma of the Ovary with a Pleural Effusion (Meigs' Syndrome).** Horace B. Anderson. *Pennsylvania M. J.* 47: 671-675, April 1944.

Unless the possibility of Meigs' syndrome—ovarian tumor, ascites, and pleural effusion—is kept in mind in the differential diagnosis of pleural effusion in women, many such cases will be diagnosed as metastatic or primary carcinoma of the lung or pleura. The ovarian tumor leading to this syndrome is usually a fibroid on the right side, and the effusion, which is also usually on the right, clears up spontaneously when the tumor is removed. Cure has never been effected by deep therapy,

and there are no reports of spontaneous disappearance of the effusion.

The author reports a case with the usual symptoms. Deep therapy to the right chest brought no change in the amount of fluid. Irradiation of the pelvis caused a decrease of fluid in the chest but recurrence was prompt. At operation a large ovarian tumor on the right side was removed. The pleural effusion disappeared and the patient made an uneventful recovery. The tumor proved to be a malignant cystadenoma.

JOSEPH T. DANZER, M.D.

## TECHNIC AND APPARATUS

**Calibration of X-Ray Equipment for Superficial Therapy.** C. E. Eddy. *Arch. Dermat. & Syph.* 49: 250-252, April 1944.

This paper was inspired by an article by Belisario and Pugh appearing in the March 1942 issue of the *Archives of Dermatology and Syphilology* (Abst. in *Radiology* 39: 381, 1942). In that article the authors listed the facilities for calibration existing in Australia, England, and America. Eddy does not believe that the statements concerning the facilities available in Australia present a fair picture. "This may be due partly to the fact that a considerable delay ensued between the collection of the data and the publication of the paper and partly to the fact that, in general, facilities for calibration of x-ray equipment are utilized somewhat earlier by radiotherapeutists than by dermatologists."

The Third Australian Cancer Conference in 1932 recommended that the Department of Health should prepare an Australian standard of roentgen dosage so that dosimeters could be checked against a free air standard dosimeter and, during the year 1933, an apparatus of the type developed at the Bureau of Standards in Washington, D. C., was set up at the Commonwealth Radium Laboratory. Later a similar instrument was set up at the University of Sydney.

Since 1935 competent physicists have at intervals calibrated the equipment at government and private hospitals. Features of the service are as follows:

1. The free air output, expressed in terms of the half-value layer, is measured for every combination of tube voltage, tube current, filtration, and focal skin distance used in treatment.
2. Treatment cones are investigated.
3. Tables showing relation between the skin dose and free air dose for various areas, qualities of radiation, and thicknesses of tissue are supplied.
4. Tables are given for different conditions of treatment, based on the work of Packard and Mayneord.
5. A technical chart is furnished, showing the time required to give certain dosages.

It is not necessary that each hospital or radiotherapeutist possess a clinical dosimeter. In fact, it is better to have a constancy meter that can at times be checked by a physicist.

JOSEPH T. DANZER, M.D.

## RADIATION EFFECTS

**Irradiation Sickness: Hypothesis Concerning the Basic Mechanism and a Study of the Therapeutic Effect of Amphetamine and Dextro-desoxyephedrine.** E. L. Jenkinson and W. H. Brown. *Am. J. Roentgenol.* 51: 496-503, April 1944.

The use of amphetamine and dextro-desoxyephed-

rine in the treatment of irradiation sickness is reported. Of 69 patients showing irradiation sickness during courses of therapy, 27 received amphetamine and 42 desoxyephedrine. No attempt was made to evaluate the relative effectiveness of the two drugs. Of the total cases, 80 per cent showed good responses, 14 per cent fair, and in 6 per cent the results were negligible with either of the two drugs. The effectiveness of the drugs appeared to be reduced by anemia, nutritional and metabolic changes associated with debilitation, and by extensive metastasis.

The dose and method of administration of the drugs are of utmost importance and must be varied according to requirements of the individual patient. The first dose is given thirty minutes before breakfast, during which time the patient remains in bed. The second dose is given at noon, and the third at 4 P.M. Five to 10 mg. of amphetamine or 2.5 to 5 mg. of *d*-desoxyephedrine are given per dose, depending upon the size of the patient and the severity of the symptoms. Usually, smaller doses are given at first, being increased until the therapeutic effect is obtained. The total daily dose does not exceed 30 mg. of amphetamine or 20 mg. of *d*-desoxyephedrine. Both are administered orally.

The authors discuss various theories and explanations of the etiology of irradiation sickness. Increased capillary permeability due to injury from the roentgen rays appears to be the basic factor. The pharmacology of the drugs employed indicates that they are of therapeutic value in irradiation sickness through their action in maintaining the peripheral circulating blood volume and preventing visceral stasis and splanchnic dilatation. It is important that corrective measures be instituted in the presence of anemia, dehydration, acidosis, and the deficiencies associated with debilitation and nutritional disturbances, since these conditions, as pointed

out above, appear to reduce the effectiveness of either drug.  
L. W. PAUL, M.D.

**Variations in Sensitiveness of Different Skin Areas to the Erythema Dose of Roentgen Radiation.** Julian B. Herrmann and George T. Pack. *Am. J. Roentgenol.* 51: 504-507, April 1944.

The sensitiveness of 13 different skin areas to low-voltage roentgen rays was tested in a group of 21 patients. Variation in sensitiveness of different skin areas in the same person and of homologous areas in different persons was encountered. The axilla and groin appeared to be the most sensitive, and the hand and foot the least sensitive. The forearm was more sensitive than the thigh, while areas over the sternum and the sixth dorsal vertebra held a position intermediate between these two. The dorsum of the hand and foot were found to be more sensitive than the palm or sole. No appreciable difference in sensitiveness was found on the basis of sex or complexion. Skin of elderly, debilitated patients appeared to be less sensitive than that of younger, more robust persons.

The radiation employed in the test consisted in doses of 400 r measured in air, using 100 kv., 6 ma., 1 mm. Al, 15 cm. target-skin distance, 2-cm. diameter cone. On any one patient, six areas were exposed to this amount of radiation, which was chosen as just above the threshold erythema dose. The areas were examined daily or every other day for two to four weeks thereafter, and the observed reactions were graded from one to four.

The reason for differences in sensitivity of various skin areas is not clear. It is probable that circulation and the thickness of the skin play a role, but this does not seem to be the entire explanation.

L. W. PAUL, M.D.





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